



September ##, 2004

Chip Humphrey
Eric Blischke
US Environmental Protection Agency, Region 10
811 SW 6th Avenue, 3rd Floor
Portland, OR 97204

Re: Lower Willamette River, Portland Harbor Superfund Site
USEPA Docket No: CERCLA-10-2001-0240
Portland Harbor RI/FS – Winter 2004 ADCP Survey

Dear Mssrs. Humphrey and Blischke:

This letter transmits the results of the Acoustic Doppler Current Profiler (ADCP) survey conducted in the Lower Willamette River on January 31, 2004 during a relatively high flow event (over 120,000 cubic feet/second). This ADCP survey was conducted by David Evans and Associates, Inc (DEA) and was comparable in scope to the ADCP survey conducted on the Lower Willamette in April 2002. Current profile data were collected along 17 cross-river transects distributed from about river mile 1 to river mile 11 and in the mouth of the Multnomah Channel.

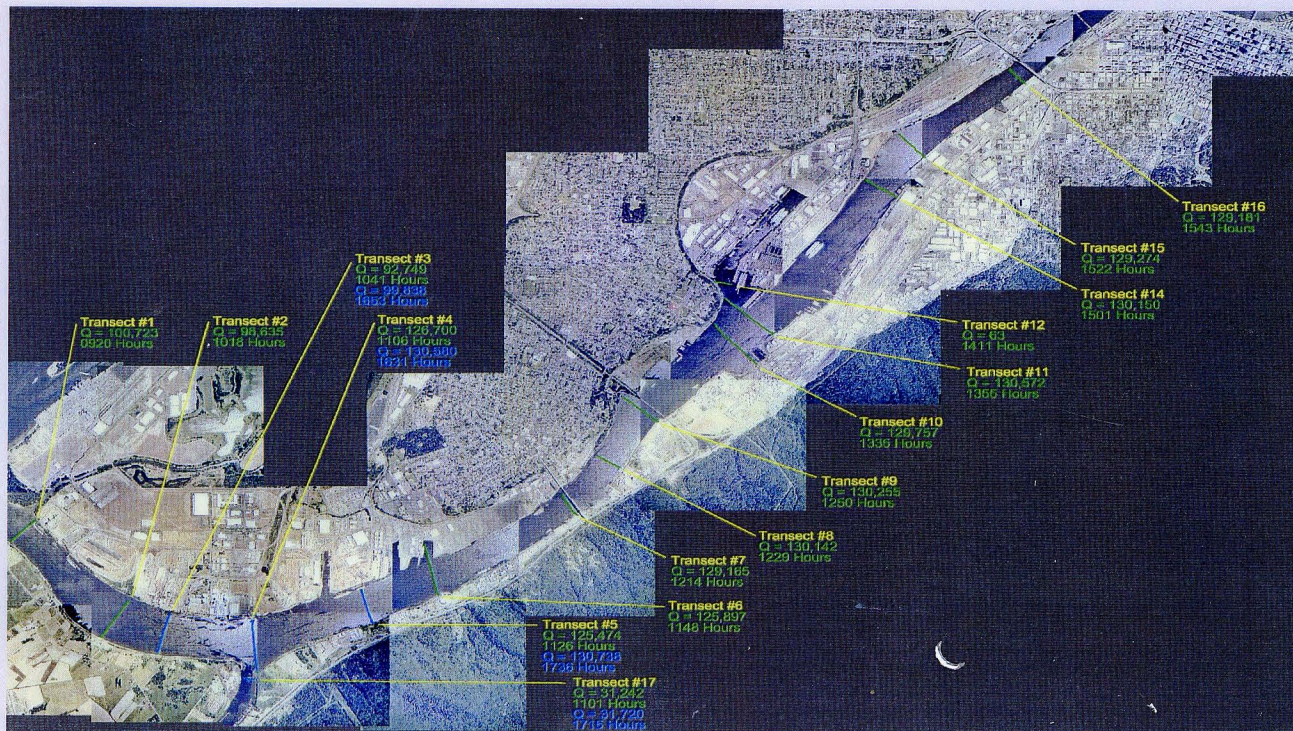
The attached report, prepared by DEA, describes the ADCP data acquisition and data processing methods and presents graphical displays of the flow measurements along each transect. The enclosed CD contains the raw ADCP data files from the survey as well as the WinRiver application (Version 1.06, RD Instruments, San Diego, CA) that allows the data to be accessed. If you have any questions, please give me a call at (360) 705-3534.

Sincerely,

Gene C. Revelas
RI Sampling Coordinator

Copies: Keith Pine, Integral Consulting, Inc.
Bob Wyatt, NW Natural, LWG Co-Chair
Jim McKenna, Port of Portland, LWG Co-Chair

*Willamette River Acoustic Doppler Current Profiler
Survey Results
January 2004*



Conducted By:

DAVID EVANS AND ASSOCIATES, INC.
2100 SW River Parkway
Portland, Oregon

Conducted For:

INTEGRAL CONSULTING, INC.
1205 West Bay Drive
Olympia, Washington

Privileged and Confidential: Work Product Prepared in Anticipation of Litigation



*Willamette River Acoustic Doppler Current Profiler
Survey Results*

January 2004



EXP: 12/31/05

Prepared by: _____

Reviewed by: _____



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Acronyms and Abbreviations

ADCP	Acoustic Doppler Current Profiler
CFS	Cubic feet per second
cm	centimeters
DEA	David Evans and Associates, Inc.
EPA	Environmental Protection Agency
GPS	Global positioning system
kCFS	thousand cubic feet per second
kHz	kilo Hertz
POS/MV	Position and orientation system for marine vessels
Q	Total Flow

**JANUARY 2004
WILLAMETTE RIVER ACOUSTIC DOPPLER CURRENT PROFILER
SURVEY RESULTS**

1.0 INTRODUCTION

David Evans and Associates, Inc. (DEA), under contract with Integral Consulting, Inc. (formerly Striplin Environmental Associates), conducted an Acoustic Doppler Current Profiler (ADCP) survey of the Lower Willamette River in January of 2004 in support of a sediment transport study for the Portland Harbor Superfund Remedial Investigation. The primary goal of the January 2004 ADCP survey was to meet a United States Environmental Protection Agency (EPA) mandate to measure current velocities within the study area during a high river flow event (over 100 kCFS). Results from the ADCP survey are to be tied to results from a multibeam bathymetric survey performed after the same high-flow event.

Since the winter of 2001, periodic bank-to-bank multibeam and ADCP surveys have been performed from River Mile 0 (at the confluence with the Columbia River) to River Mile 15.6 (at the upper end of Ross Island). In the Spring of 2002, while the Willamette River was at a high level, David Evans and Associates, Inc. (DEA) conducted a series of current monitoring transects in the Portland Harbor. This investigation was intended as an overview of current velocities and direction over the lower 15 miles of the Willamette River. A more thorough analysis of the area surrounding Multnomah Channel was conducted in May of 2003 during a tidal exchange in the Portland Harbor. River flows in this area are complicated by flows down the Willamette River, the Columbia River (3 miles down river), Multnomah Channel (a 36 mile channel to the Columbia River near St. Helens, Oregon) and the influence of tidal exchanges in Multnomah Channel and the Columbia River.

The results from this survey will be used to support hydrodynamic/sedimentation modeling during the Remedial Investigation. Survey operations were conducted on January 31, 2004 during a 130 kCFS event. This report describes the technology used during the survey, data acquisition methodology, data processing procedures and results.

2.0 ACOUSTIC DOPPLER CURRENT PROFILING (THEORY OF OPERATION)

The ADCP estimates horizontal and vertical velocity as a function of depth by using the Doppler effect to measure the radial relative velocity between the instrument and scatterers in the water column. Three acoustic beams in different directions are the minimal requirement for measuring the three velocity components. A fourth beam adds redundancy and an error estimate. The ADCP transmits a ping from each transducer element roughly once per second. The echo arrives back at the instrument over an extended period, with echoes from shallow depths arriving sooner than ones from greater ranges. Profiles are produced by range-gating the echo signal, which means the echo is broken into successive segments called depth bins which correspond to successively deeper depth ranges. The operator configures the length of each depth bin and the transmit pulse, which determines the degree of averaging in the vertical, depending on whether one is interested more in vertical resolution or profile penetration. The relative velocities are rotated from the transducers to the earth's reference frame using the units internal compass or an externally supplied heading. Finally, relative velocities and various ancillary parameters are stored on the survey vessel as raw data files. In shallow areas, such as in rivers, the ADCP can "lock on" to the bottom and use the bottom track as a very stable reference point from which to calculate absolute

speed and direction of the unit. This information on the instrument speed and direction is then subtracted from the relative current information to produce true current velocity and direction.

3.0 DATA ACQUISITION

On January 31, 2004 DEA used the 30-foot survey vessel *John B. Preston* to conduct Acoustic Doppler Current Profile (ADCP) measurements across the lower Willamette River near Portland, Oregon. Seventeen transects located between miles 0 and 11 were profiled over a 9 hour period during the peak discharge of the flood event. Appendix B includes a graph of observed water levels on the Willamette at the Morrison Bridge (river mile 12.8), the Clackamas River and the Willamette River at the Oregon City falls. Also included is a graphic of average flow (Q) from the ADCP in relation to observed water levels at the Morrison Bridge. The spatial distribution of the average flow (discharge) is presented in Figure 1. In addition to the graphs, Appendix B includes tabular data of measured average flow, automated water level observations and staff gauge observations during the survey.

An RD Instruments 1200 kHz Workhorse Sentinel ADCP was deployed from a rigid pole mounted on the starboard side of the vessel. Although the unit has an internal compass, the ADCP was integrated with a more precise heading from the POS/MV GPS/inertial heading system aboard the survey vessel. An external heading bias of 3.3 degrees was applied during processing. A draft correction of 2.10 feet was logged and applied to the ADCP data. The system was configured to collect data at 50 cm (1.64 feet) depth intervals and had a blank after transmit set to 25 cm (0.82 feet) to reduce spurious readings from close to the transducers. The 50 cm bin setting corresponds to approximately 7 cm per second precision on the readings. The set of depth bins recorded with each transmission cycle is referred to as an ensemble. Transit speed was kept to bare minimum to reduce the magnitude of the vessel vector relative to the river currents. This also enabled more along track acoustic pings to be averaged in post processing to improve the signal to noise ratio.

The 17 transect locations (Figure 1) had been determined in advance and corresponded to specific areas of interest previously surveyed. The river elevations were determined by downloading logged data at a gauge close to the transect locations. Supplementary flow information is included in Appendix B.

The ADCP Winriver software, which was used to log the raw data in the field, saves the files with the date and time in the filename each time logging is commenced. The files recorded in the field are listed in the daily log that can be found in Appendix C. The r.000 files are raw ADCP files while the w.000 are configuration files stored during acquisition. The w.001 files contain any post-processing changes to the data that may have been made. A summary of transect names and locations is provided in Table 1.

Table 1: Transect Locations

Transect	ADCP FILE *.000	RIVER MILE	LOCATION DESCRIPTION
1	Will_20040131092102_000r.	1.0	
2	Will_20040131101800_000r	2.0	
3 AM	Will_20040131104125_000r	2.5	
3 PM	Will_20040131165350_000r		
4 AM	Will_20040131110628_000r	3.1	Upstream of Multnomah Channel Entrance
4 PM	Will_20040131163124_000r		
5 AM	Will_20040131112600_000r	4.0	
5 PM	Will_20040131173608_000r		
6	Will_20040131114841_000r	4.6	Into Terminal 4 Slip 3
7	Will_20040131121449_000r	5.8	St. John's Bridge
8	Will_20040131122905_000r	6.3	Off Gasco
9	Will_20040131125046_000r	6.8	Into Willamette Cove
10	Will_20040131133517_000r	7.8	Off Willbridge Terminal
11	Will_20040131135509_000r	8.0	
12	Will_20040131141118_000r		Swan Island Lagoon (mouth)
13	Did not run this transect.		Swan Island Lagoon (upper end)
14	Will_20040131150154_000r	9.6	Across deep hole in channel
15	Will_20040131152224_000r	10.0	
16	Will_20040131154356_000r	11.0	
17 AM	Will_20040131110150_000r	3.0	Across Multnomah Channel
17 PM	Will_20040131171510_000r		

4.0 DATA PROCESSING

The raw ADCP files were replayed using WinRiver software. After replay, a screen grab was taken and saved as a jpeg image for presentation in this report. Appendix A includes an image of measurements for each transect. A five ensemble average was applied in the along track direction to improve the data quality. For calculation of flow (Q) through the transect from bank to bank, distances to the bank were measured using an Advantage Laser handheld range finder. The distances were measured from the ADCP at the end of the transect to the edge of bank. The Q calculations extrapolate the closest bank velocities over the distance to the bank and assume a bottom shape as specified by the user. For these profiles a triangular bottom shape was applied for the region being estimated. The Q information is located in the lower right hand areas of each transect plot. In the upper right section of each transect plot is an X, Y graph depicting transect path and a depth averaged stick plot of the current vector. The upper profile of each transect plot shows a color plot of the projected current velocities perpendicular to the transect. The lower profile shows a color plot of the current direction which directly correlates to the velocity data above. A copy of the WinRiver software and all of the raw data files have been included on a CD-Rom located in the back of this report.

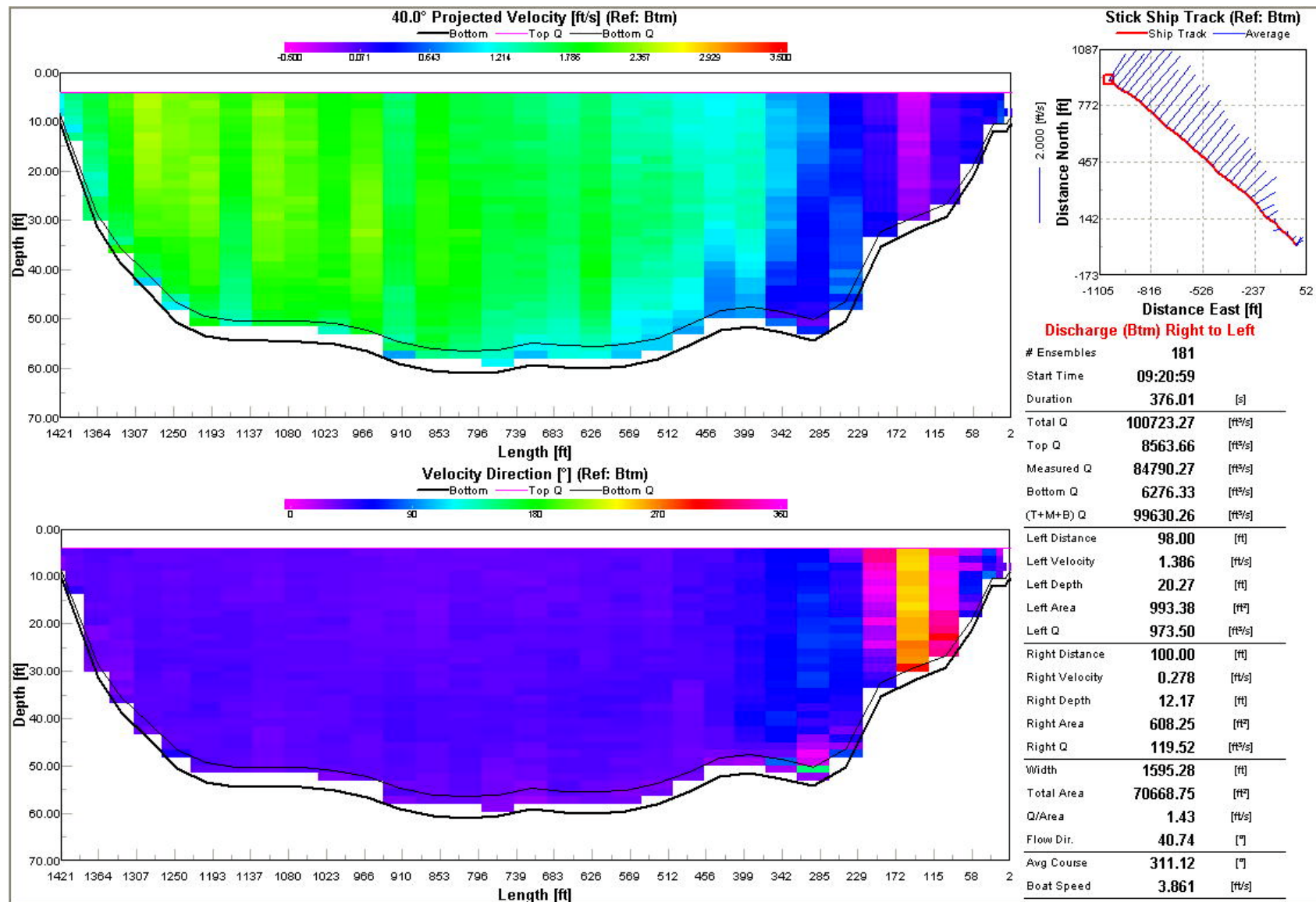
FIGURE 1: TRANSECT LOCATIONS AND DISCHARGE VALUES (CFS)
JANUARY 31, 2004
WILLAMETTE RIVER, PORTLAND, OREGON



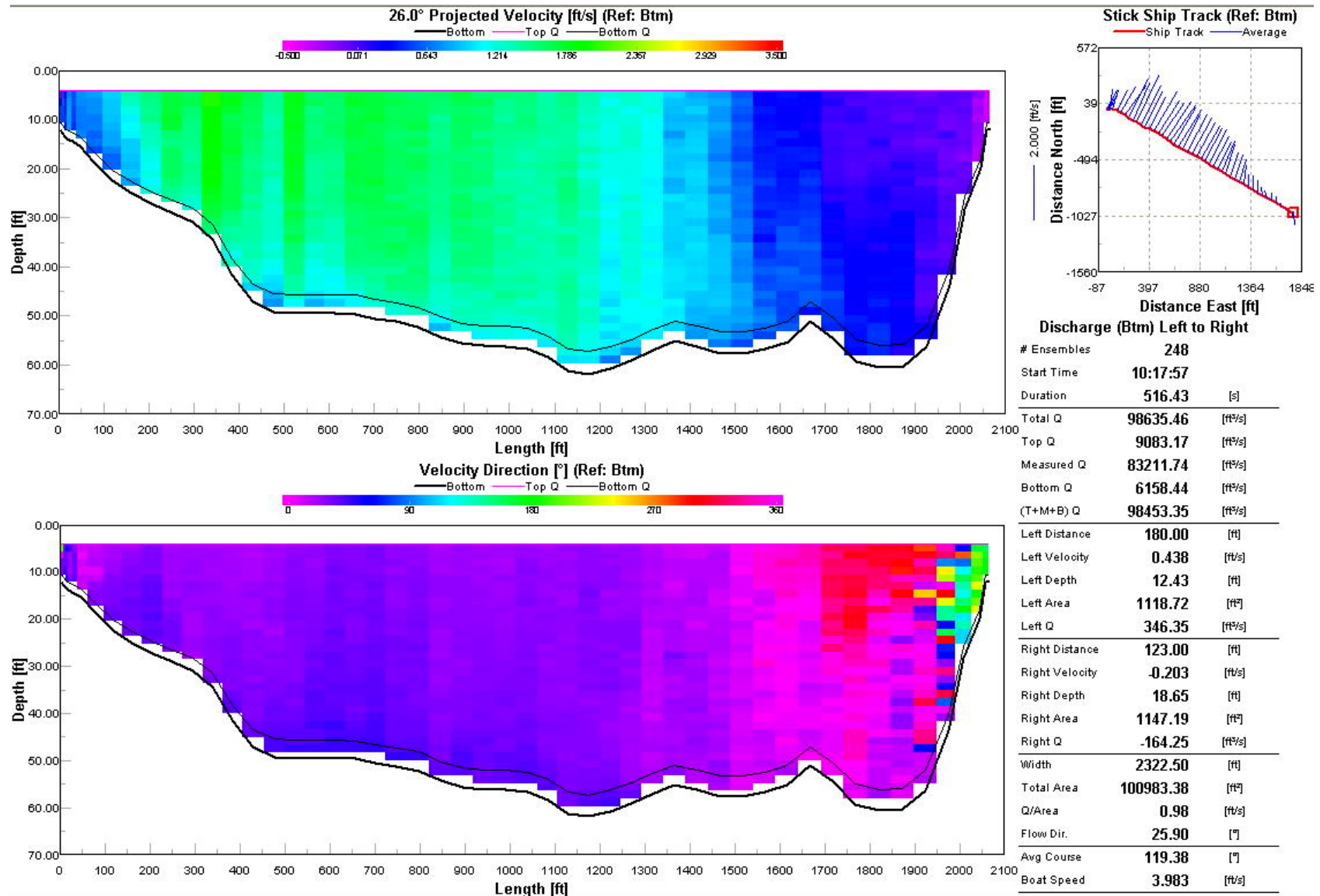
**DAVID EVANS
AND ASSOCIATES INC.**
2100 Southwest River Parkway
Portland Oregon 97201
Phone: 503.223.6663

APPENDIX A

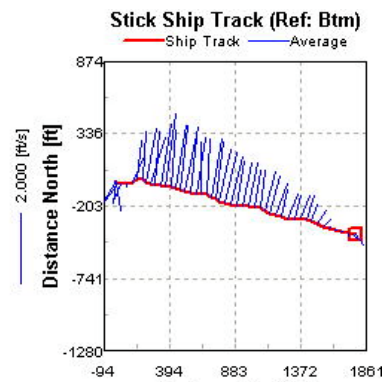
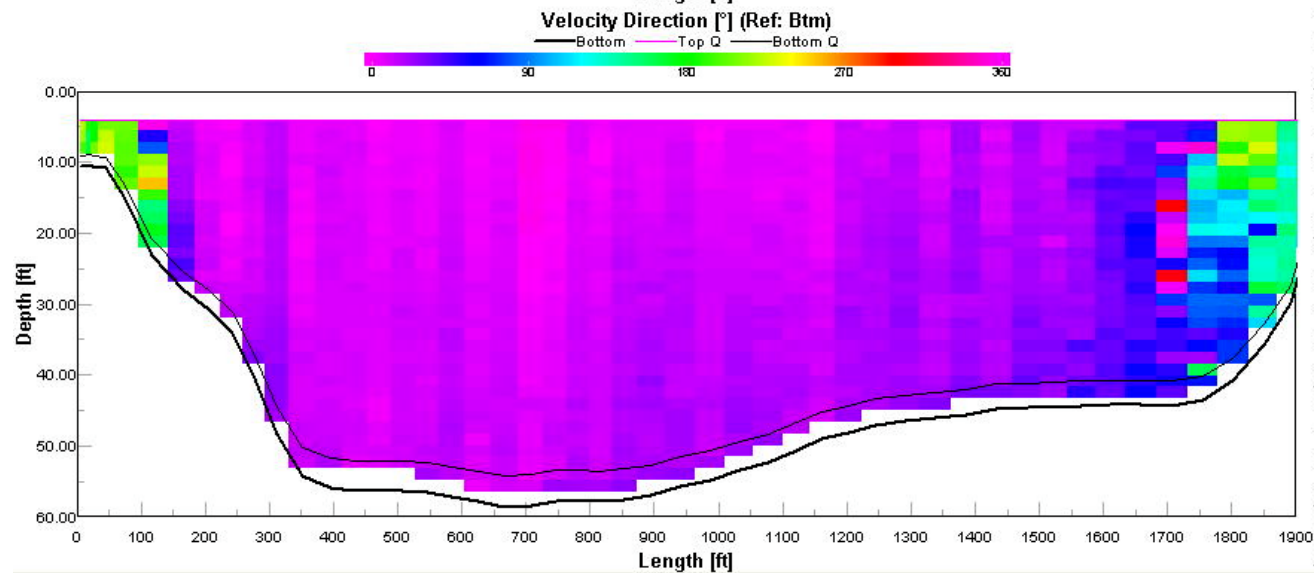
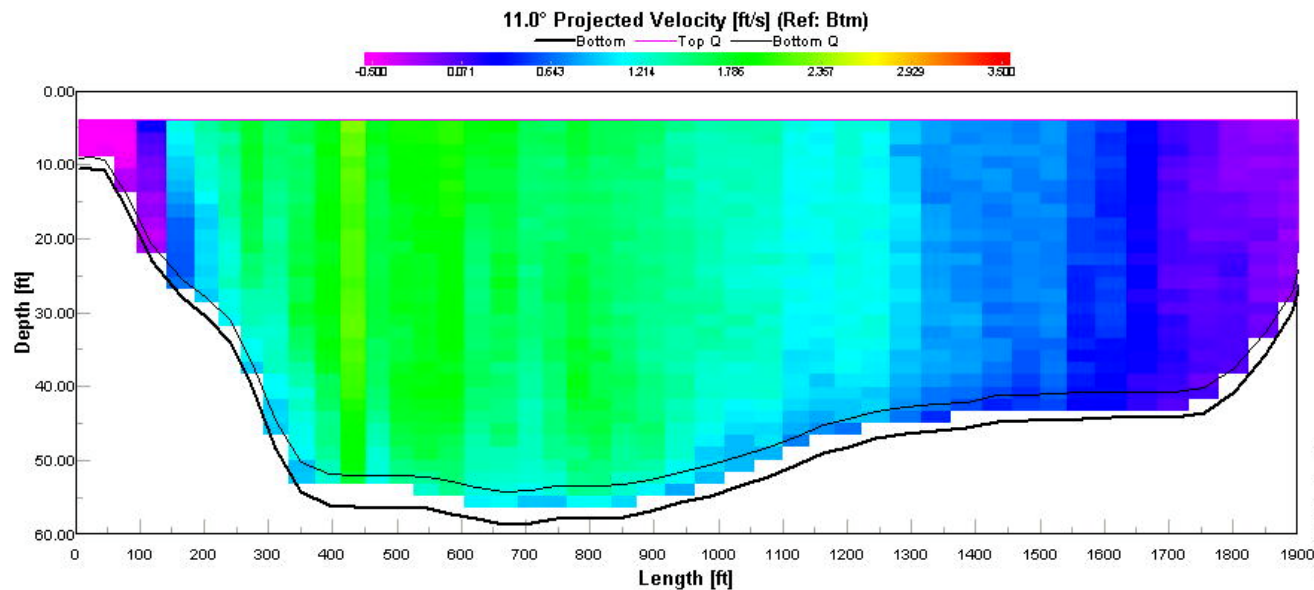
TRANSECT PROFILES



Transect 1 at 09:20 hours – River Mile 1.0



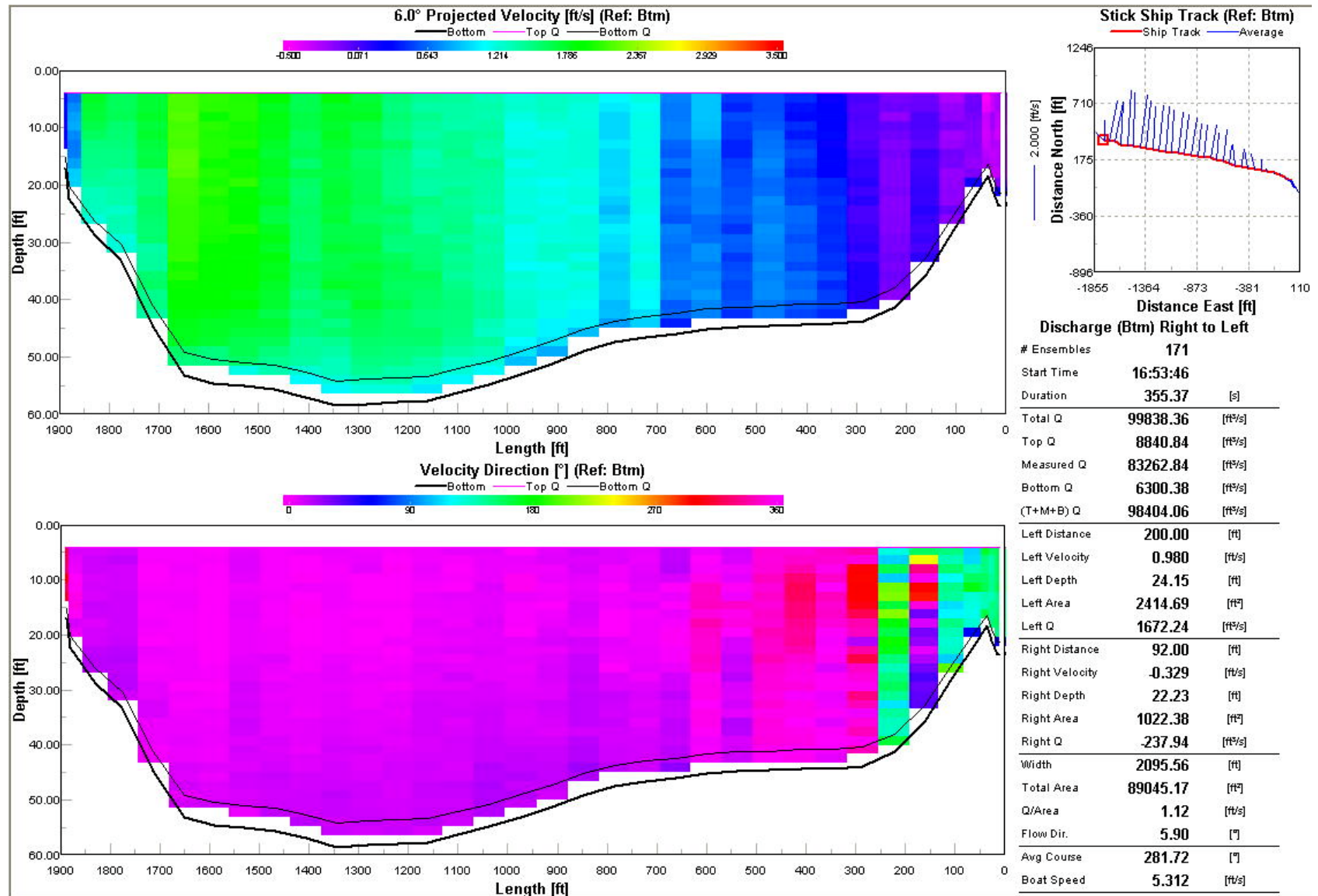
Transect 2 at 10:18 hours – River Mile 2.0



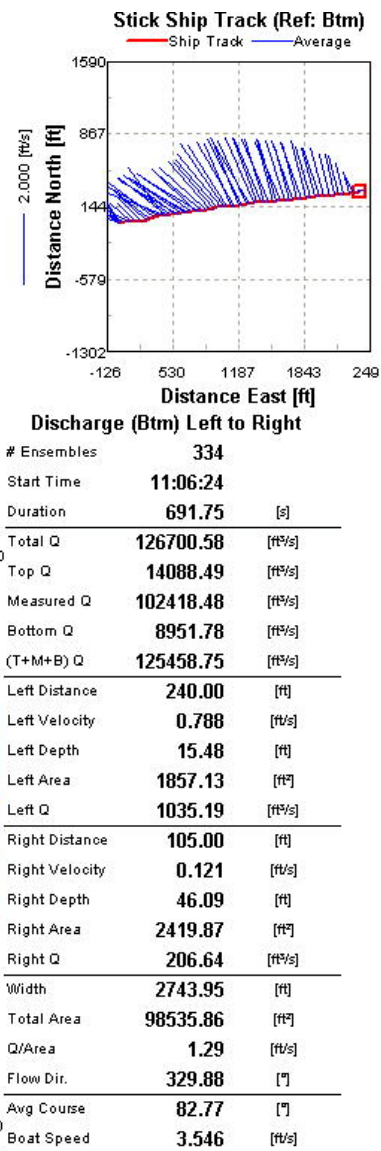
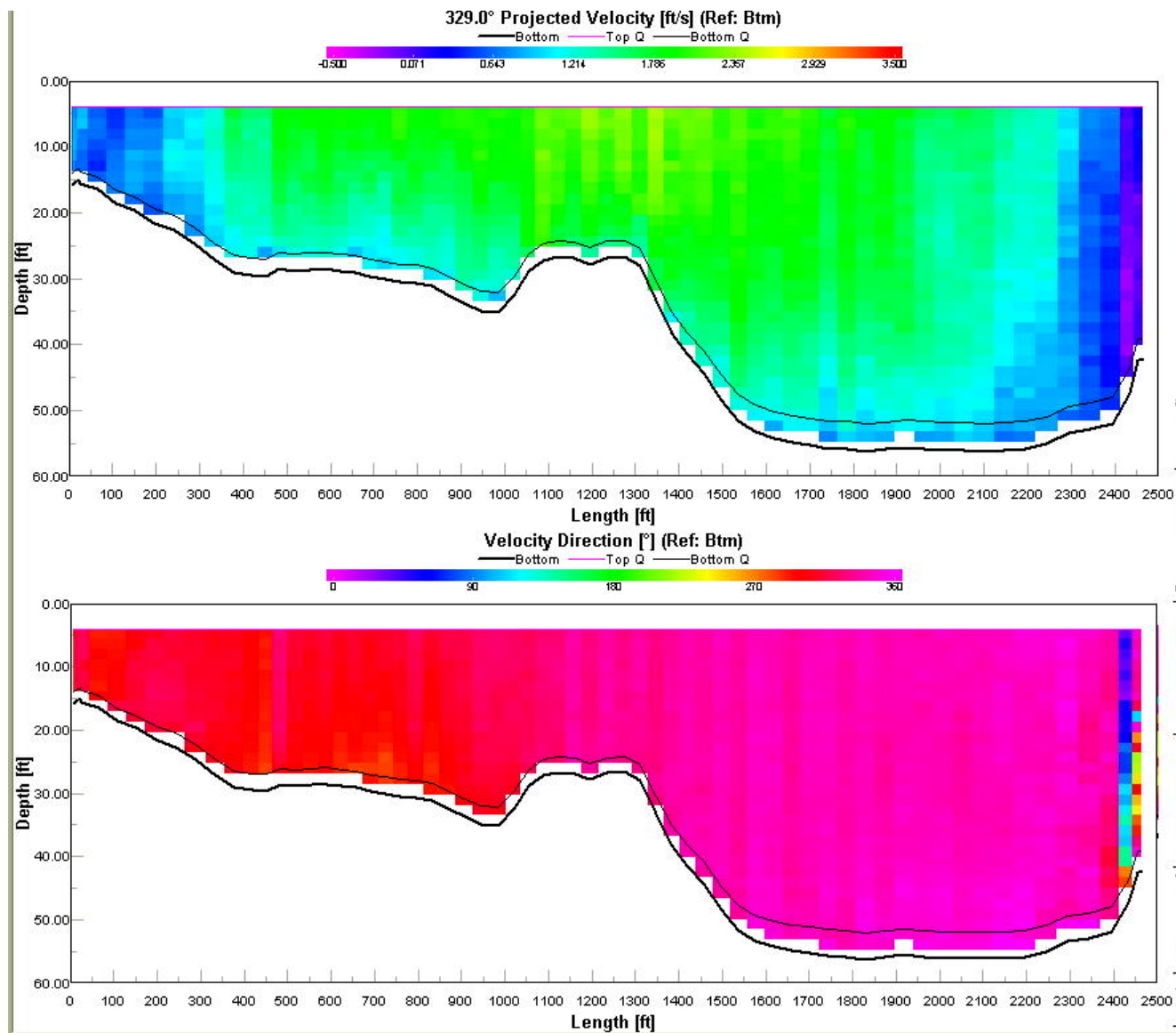
Discharge (Btm) Left to Right

# Ensembles	244	
Start Time	10:41:21	
Duration	507.78	[s]
Total Q	92739.36	[ft ³ /s]
Top Q	8052.47	[ft ³ /s]
Measured Q	79828.45	[ft ³ /s]
Bottom Q	5725.16	[ft ³ /s]
(T+M+B) Q	93606.07	[ft ³ /s]
Left Distance	200.00	[ft]
Left Velocity	-0.913	[ft/s]
Left Depth	10.39	[ft]
Left Area	1038.65	[ft ²]
Left Q	-670.32	[ft ³ /s]
Right Distance	75.00	[ft]
Right Velocity	-0.266	[ft/s]
Right Depth	27.84	[ft]
Right Area	1043.84	[ft ²]
Right Q	-196.40	[ft ³ /s]
Width	2092.71	[ft]
Total Area	87588.08	[ft ²]
Q/Area	1.06	[ft/s]
Flow Dir.	11.55	[°]
Avg Course	102.86	[°]
Boat Speed	3.760	[ft/s]

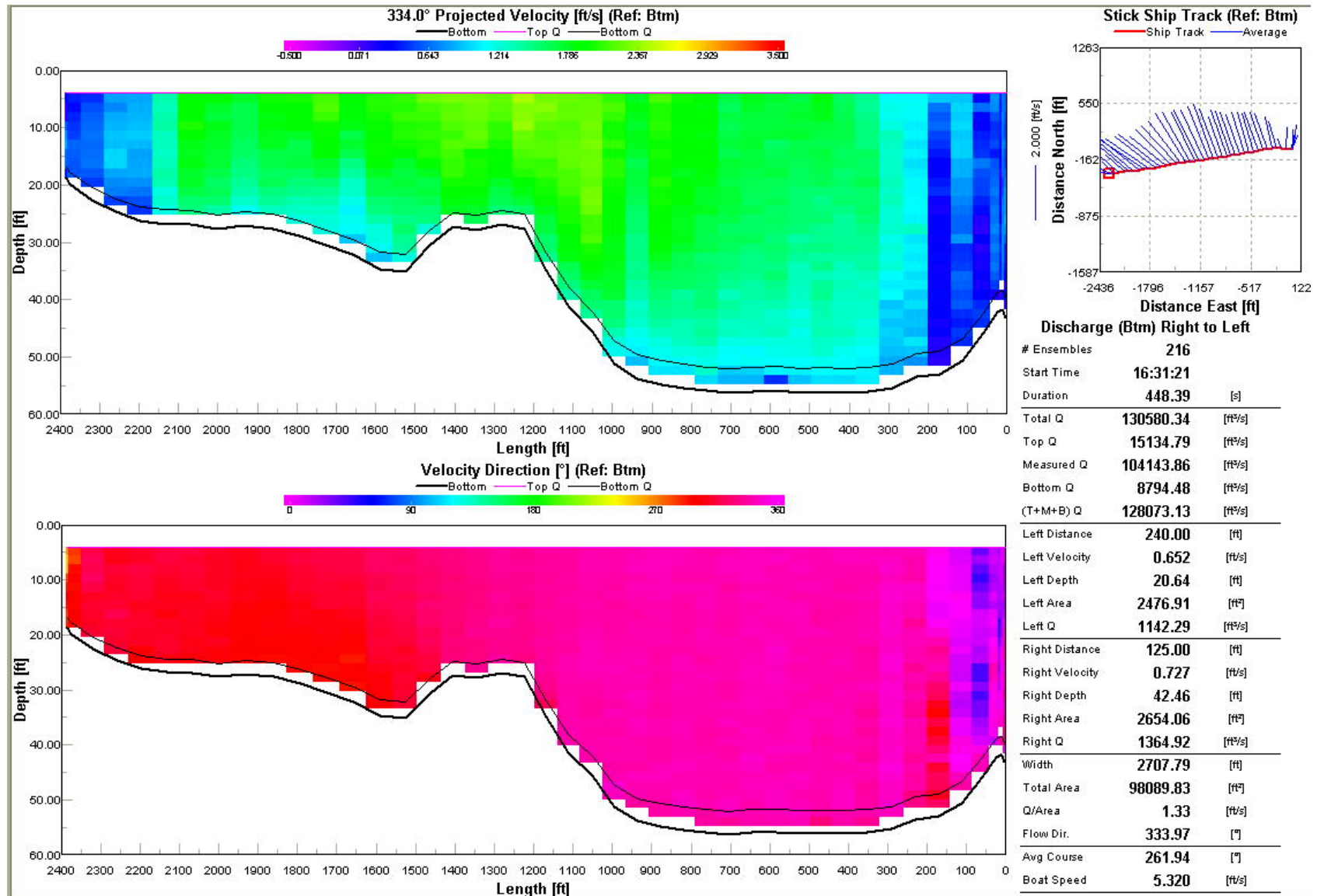
Transect 3 at 10:41 hours – River Mile 2.5



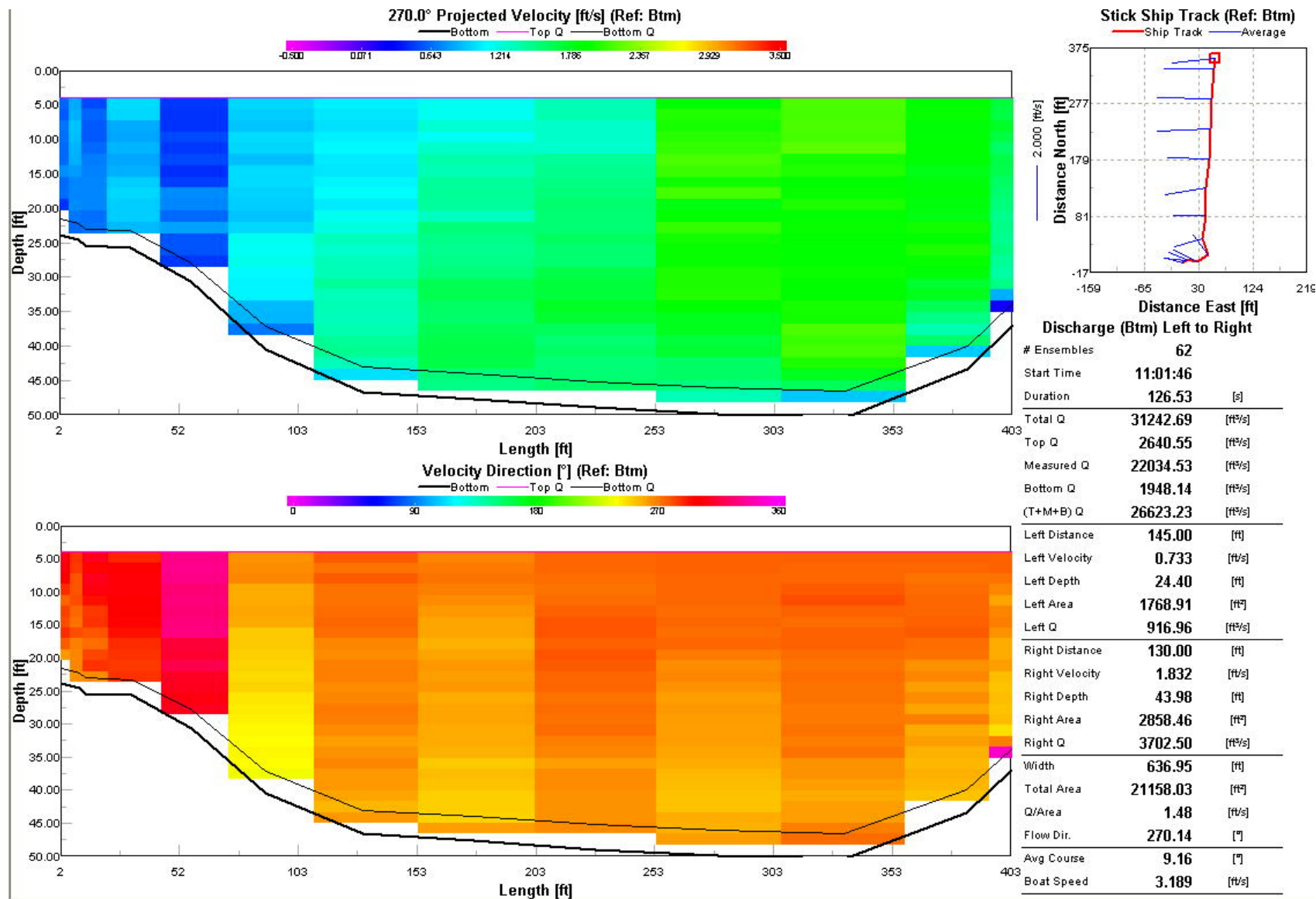
Transect 3 at 16:53 hours – River Mile 2.5



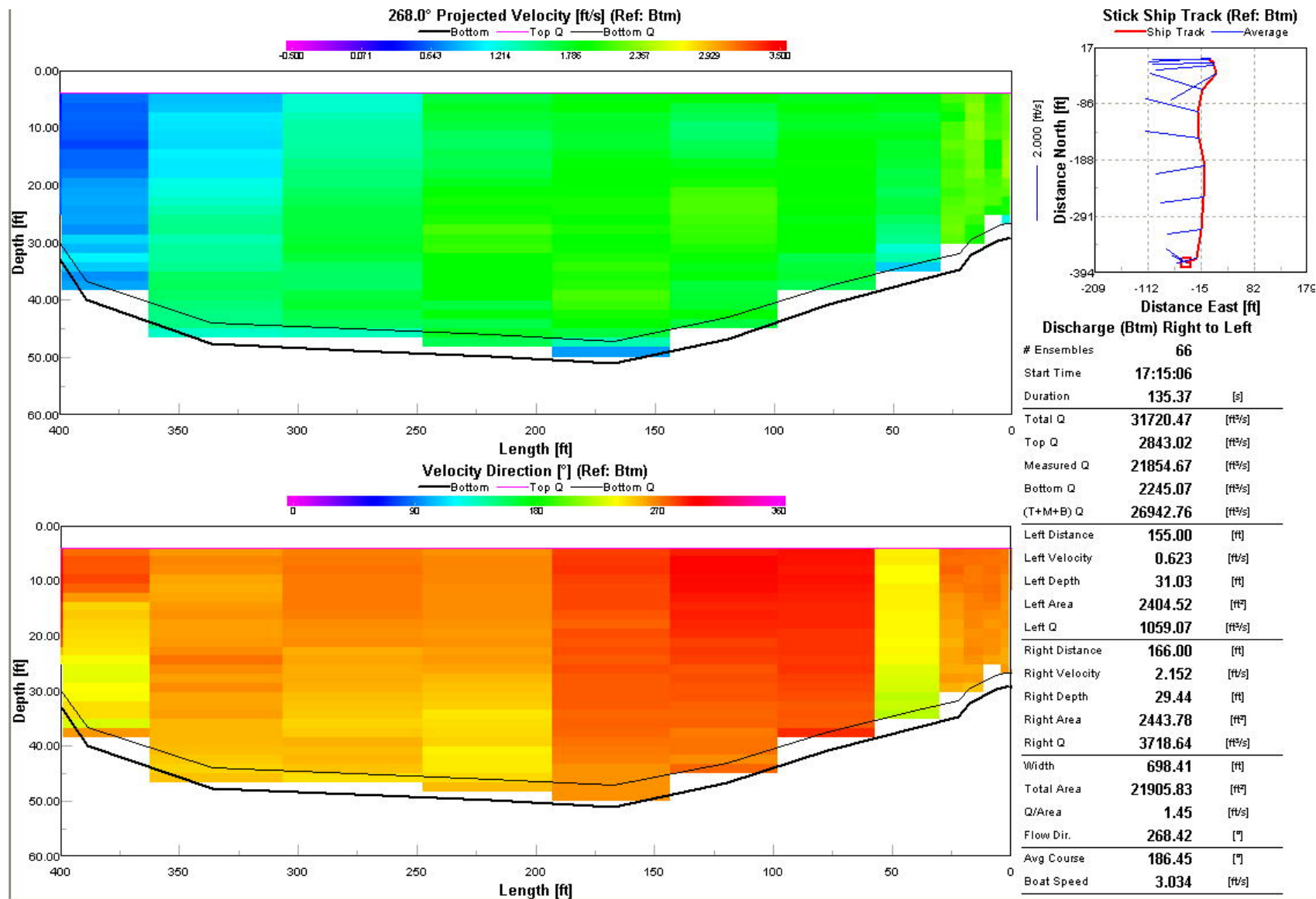
Transect 4 at 11:06 hours – River Mile 3.1 at Entrance to Multnomah Channel



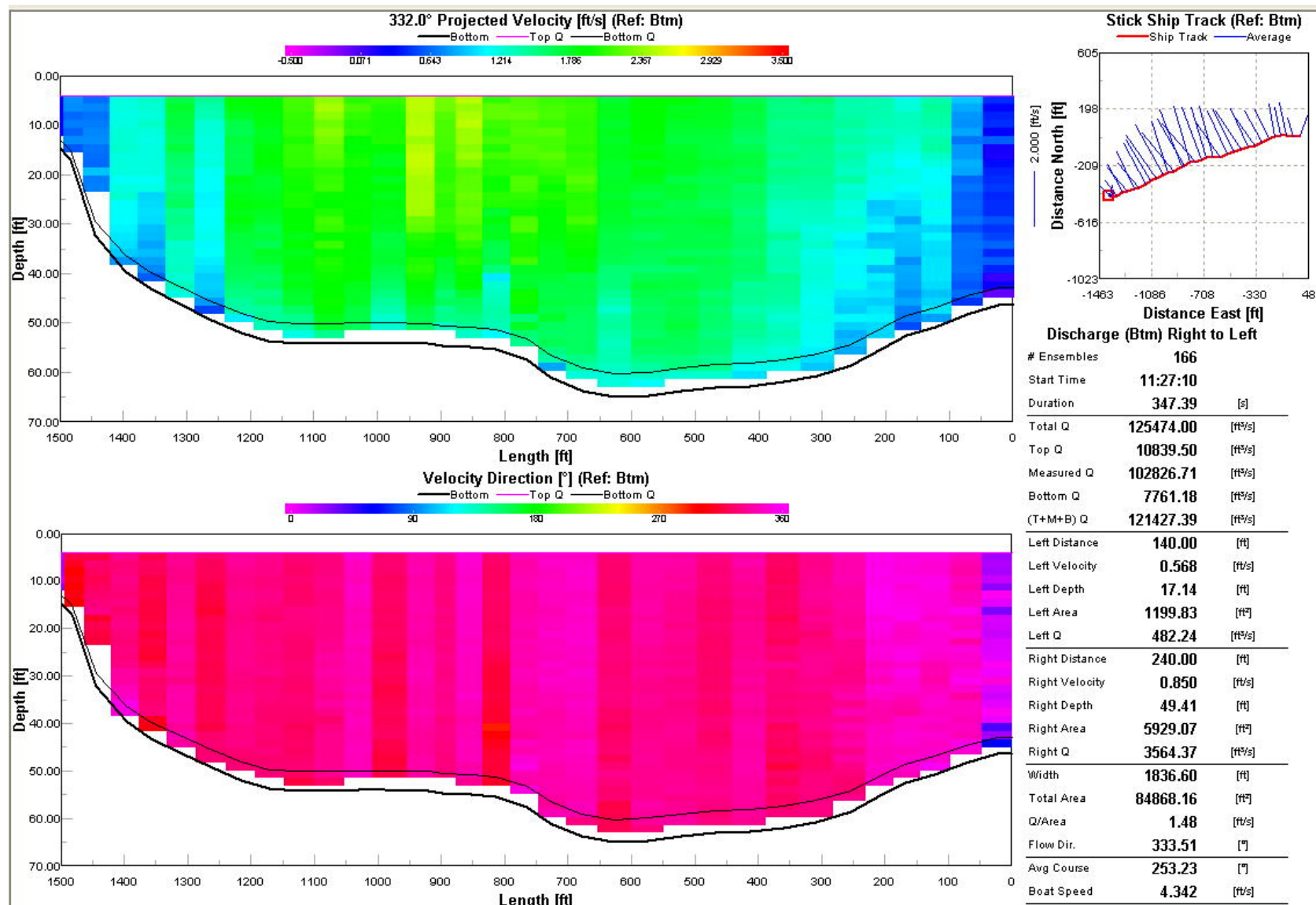
Transect 4 at 16:31 hours – River Mile 3.1 at Entrance to Multnomah Channel



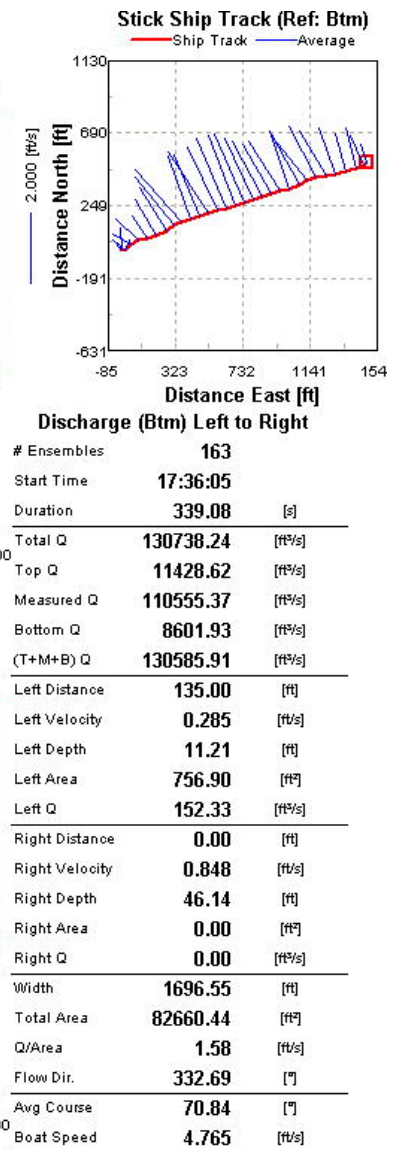
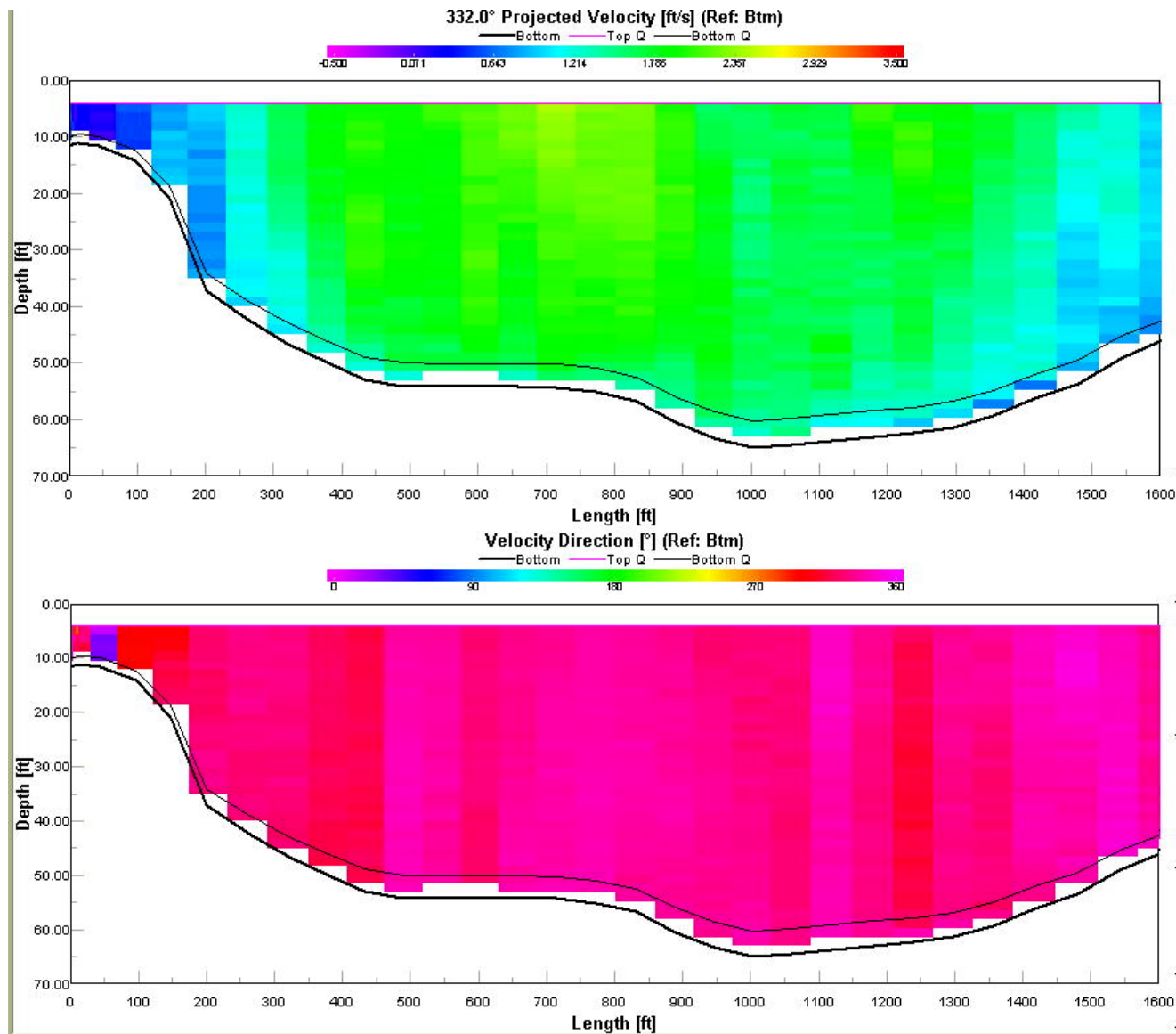
Transect 17 at 11:01 hours – Multnomah Channel



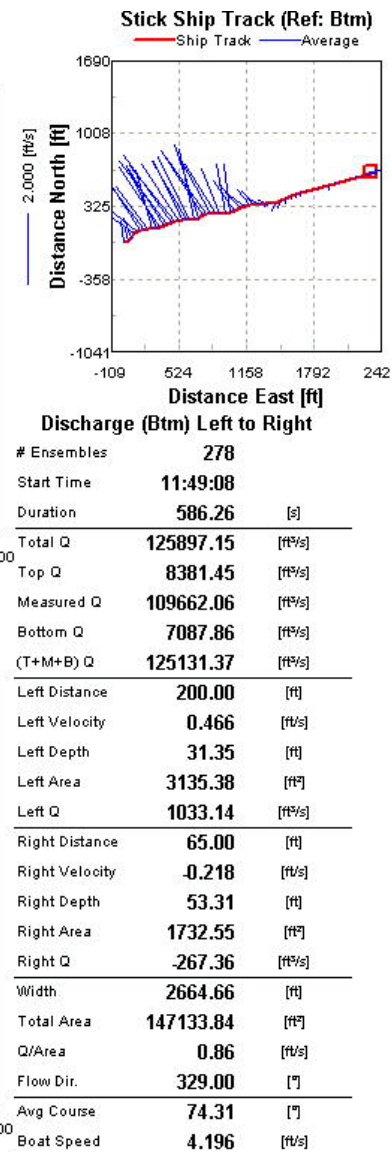
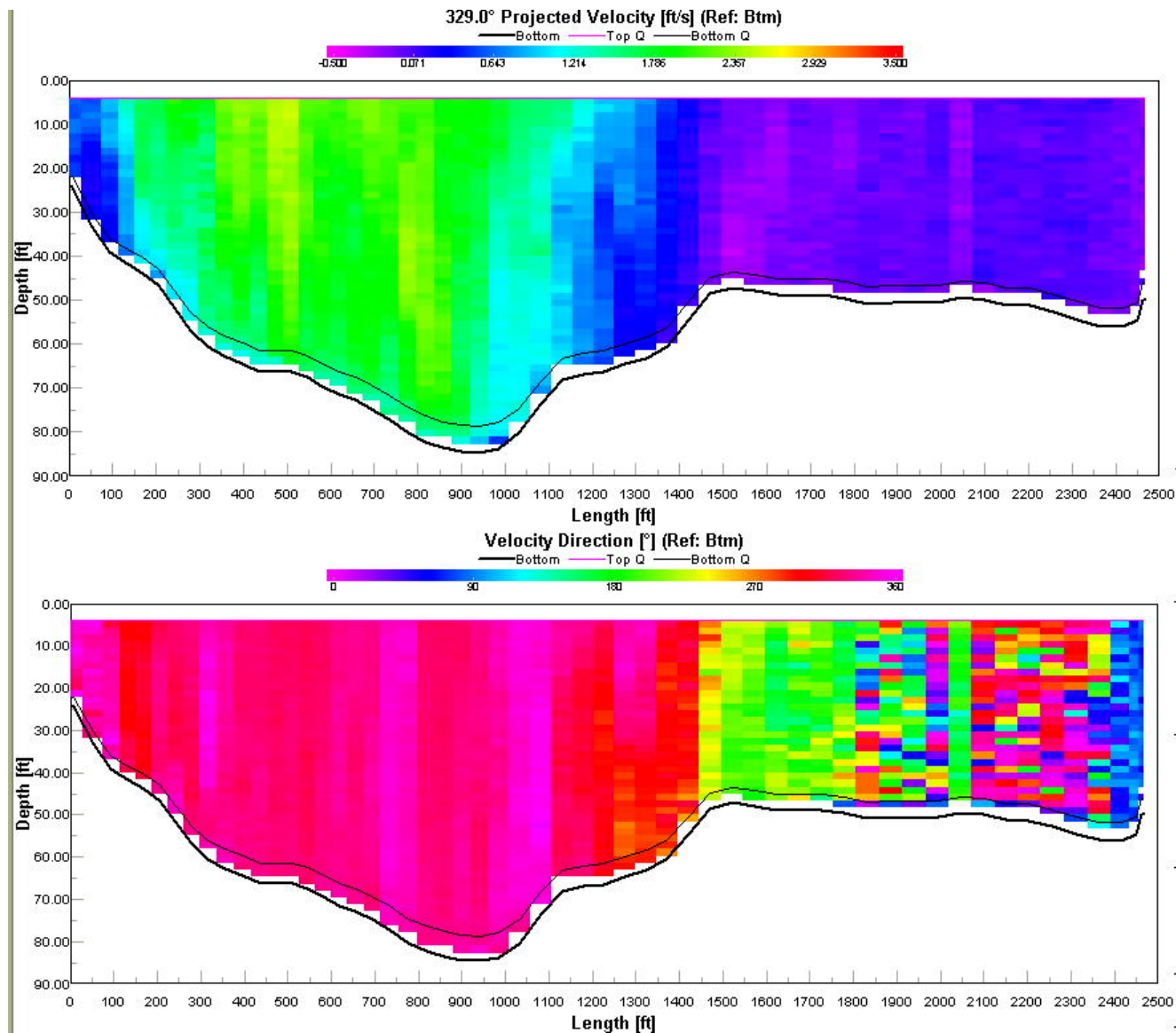
Transect 17 at 17:15 hours – Multnomah Channel



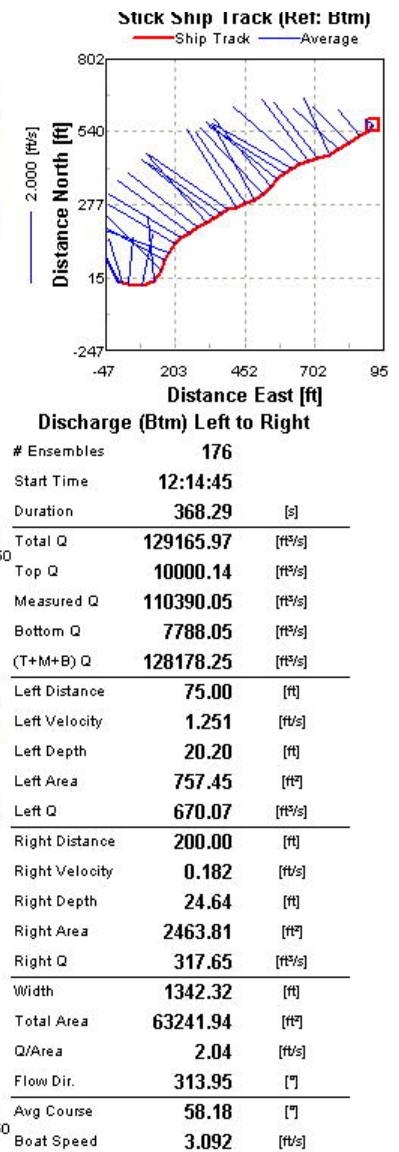
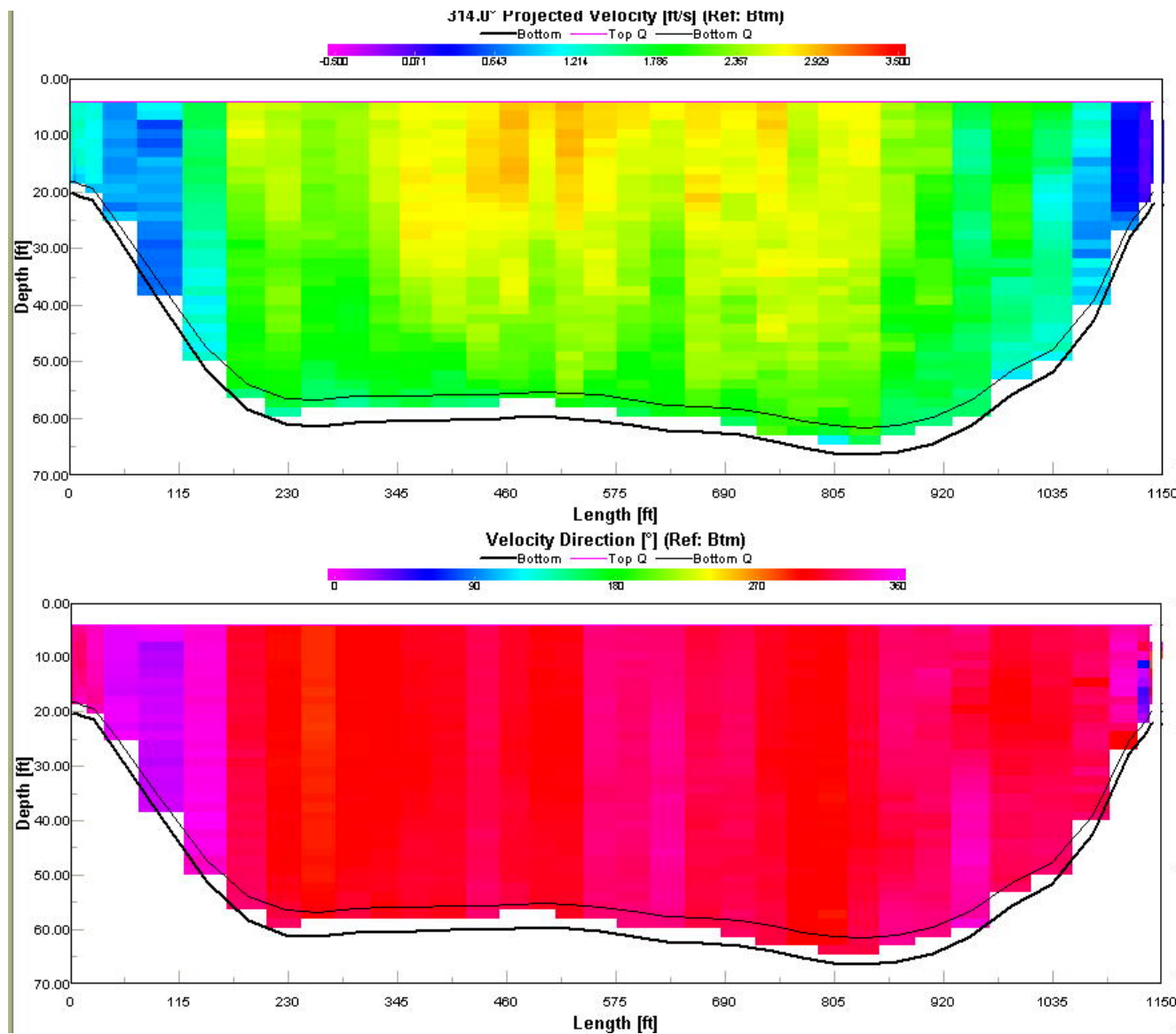
Transect 5 at 11:26 hours – River Mile 4.0



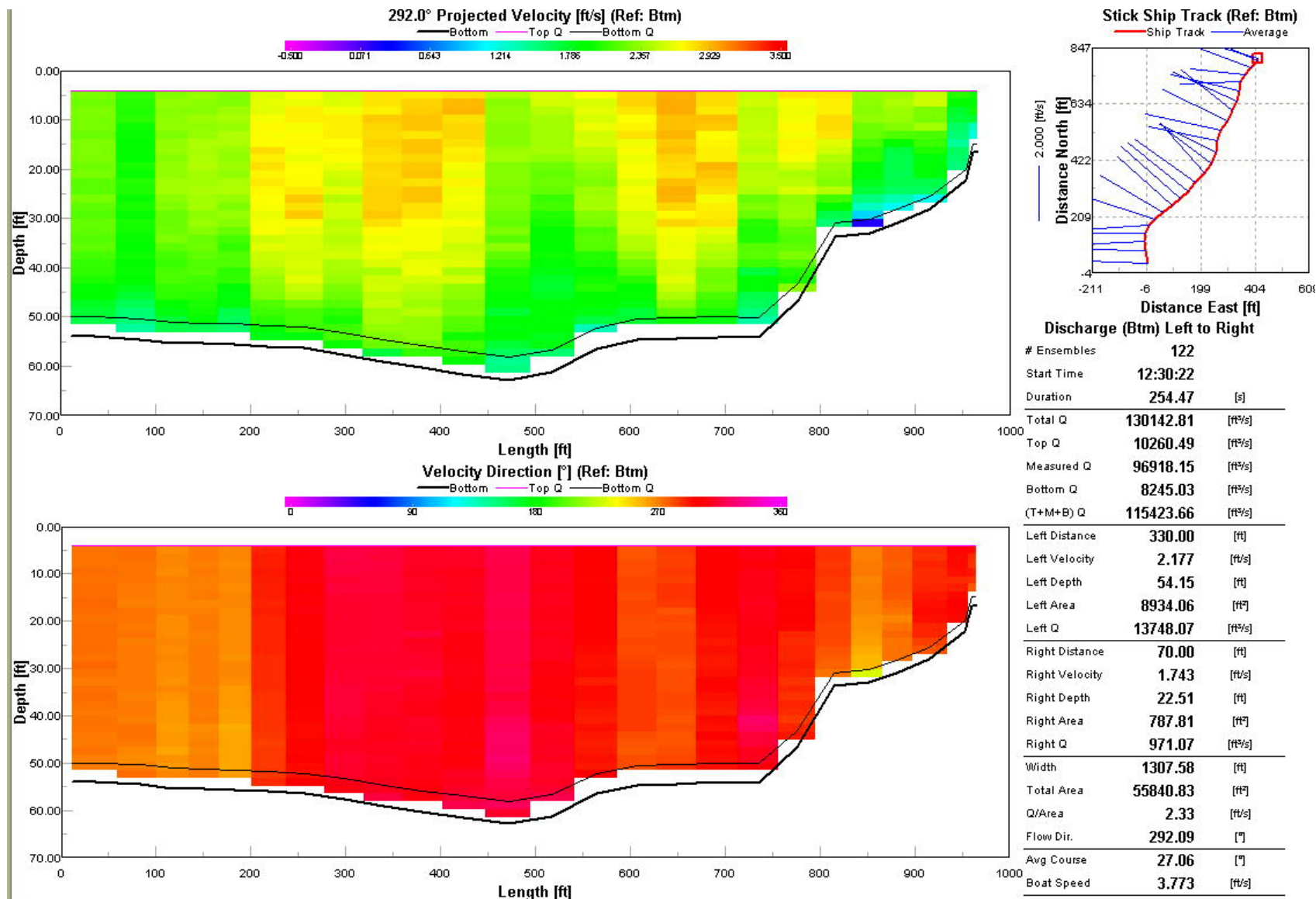
Transect 5 at 17:36 hours – River Mile 4.0



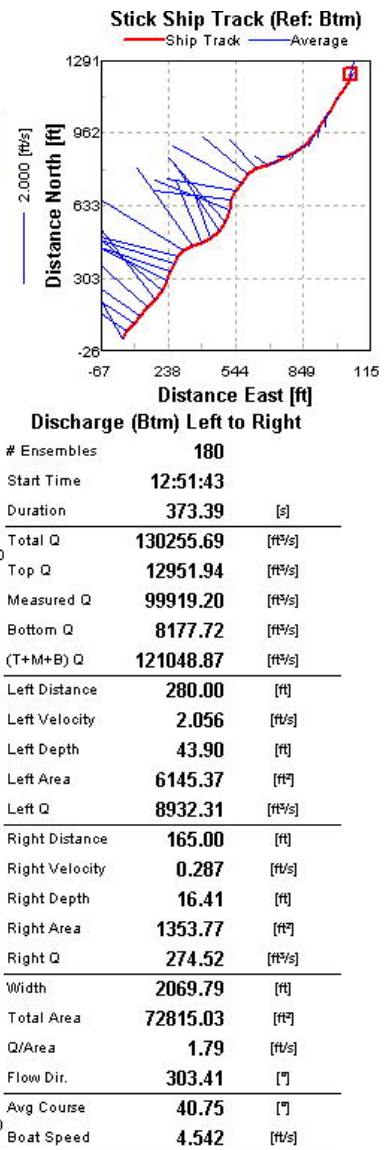
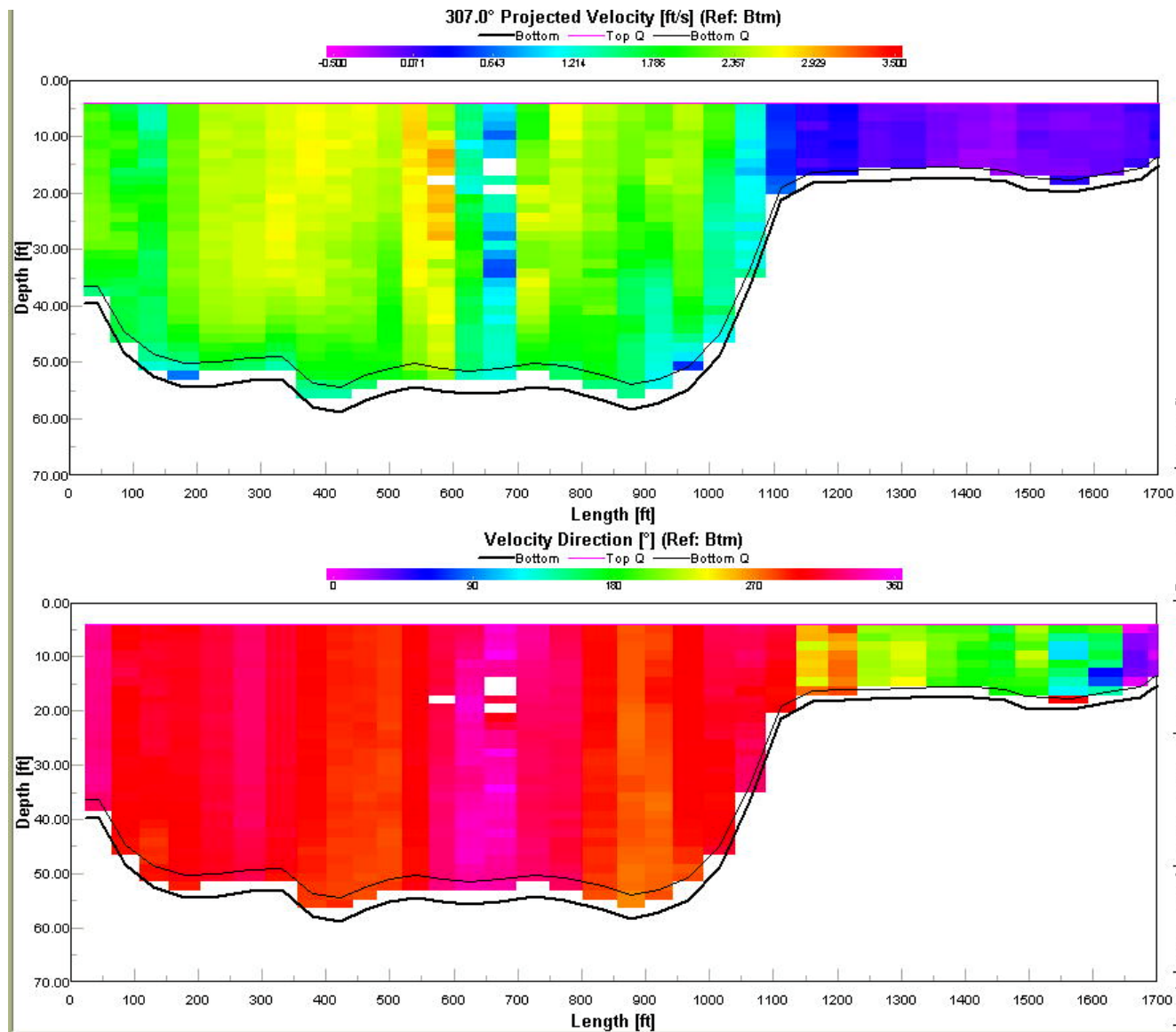
Transect 6 at 11:48 hours – River Mile 4.6



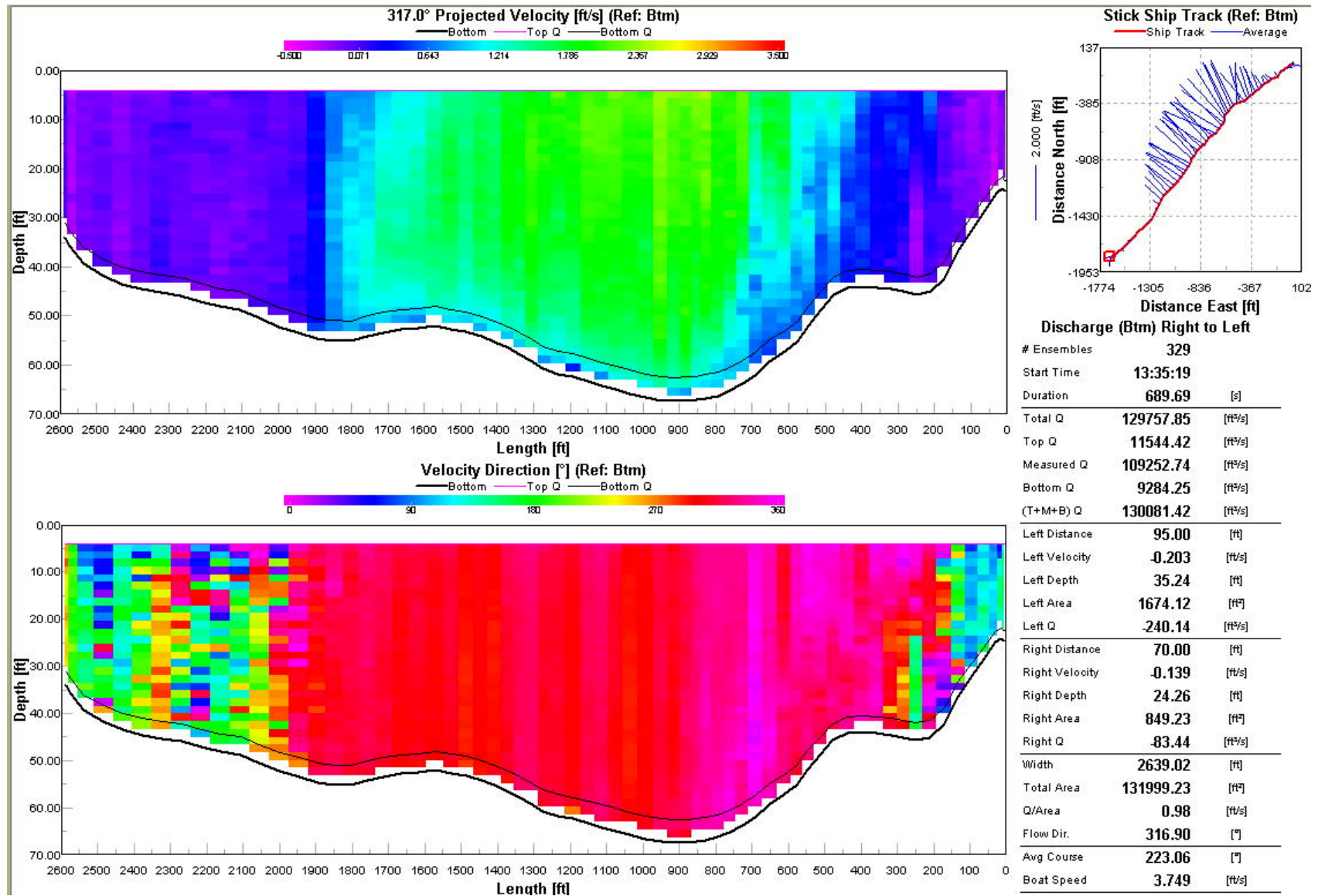
Transect 7 at 12:25 hours – River Mile 5.8



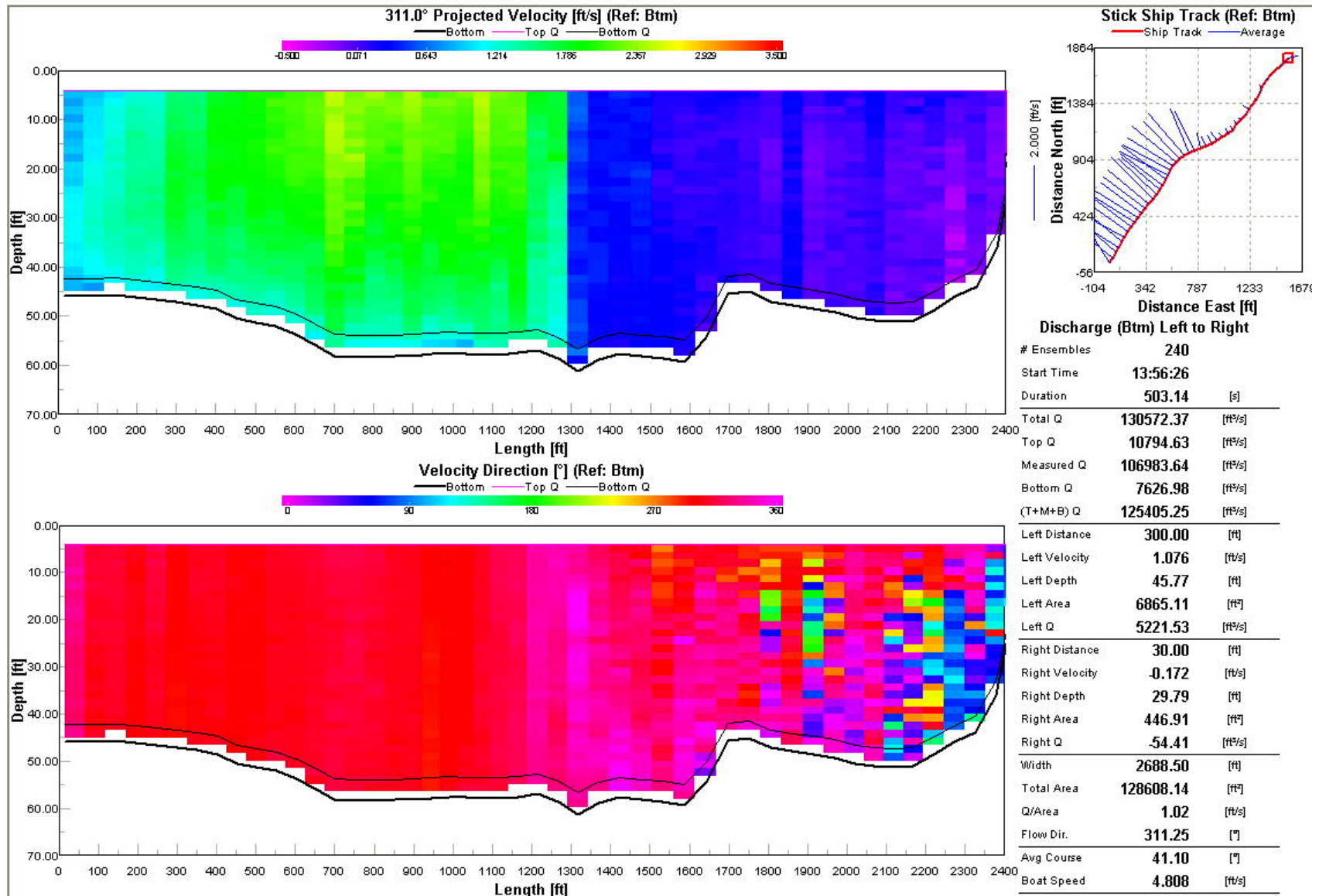
Transect 8 at 12:29 hours – River Mile 6.3



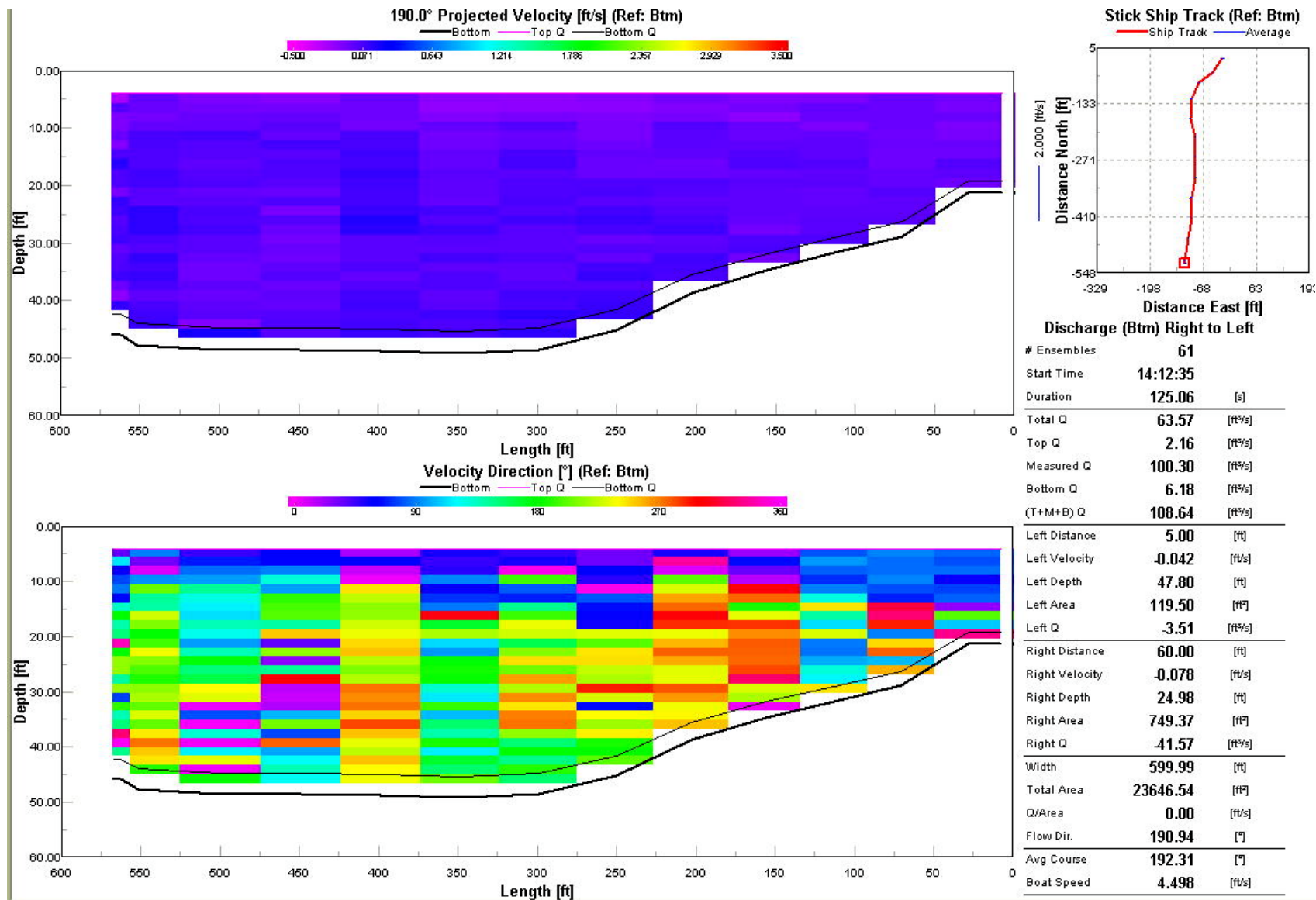
Transect 9 at 12:50 hours – River Mile 6.8



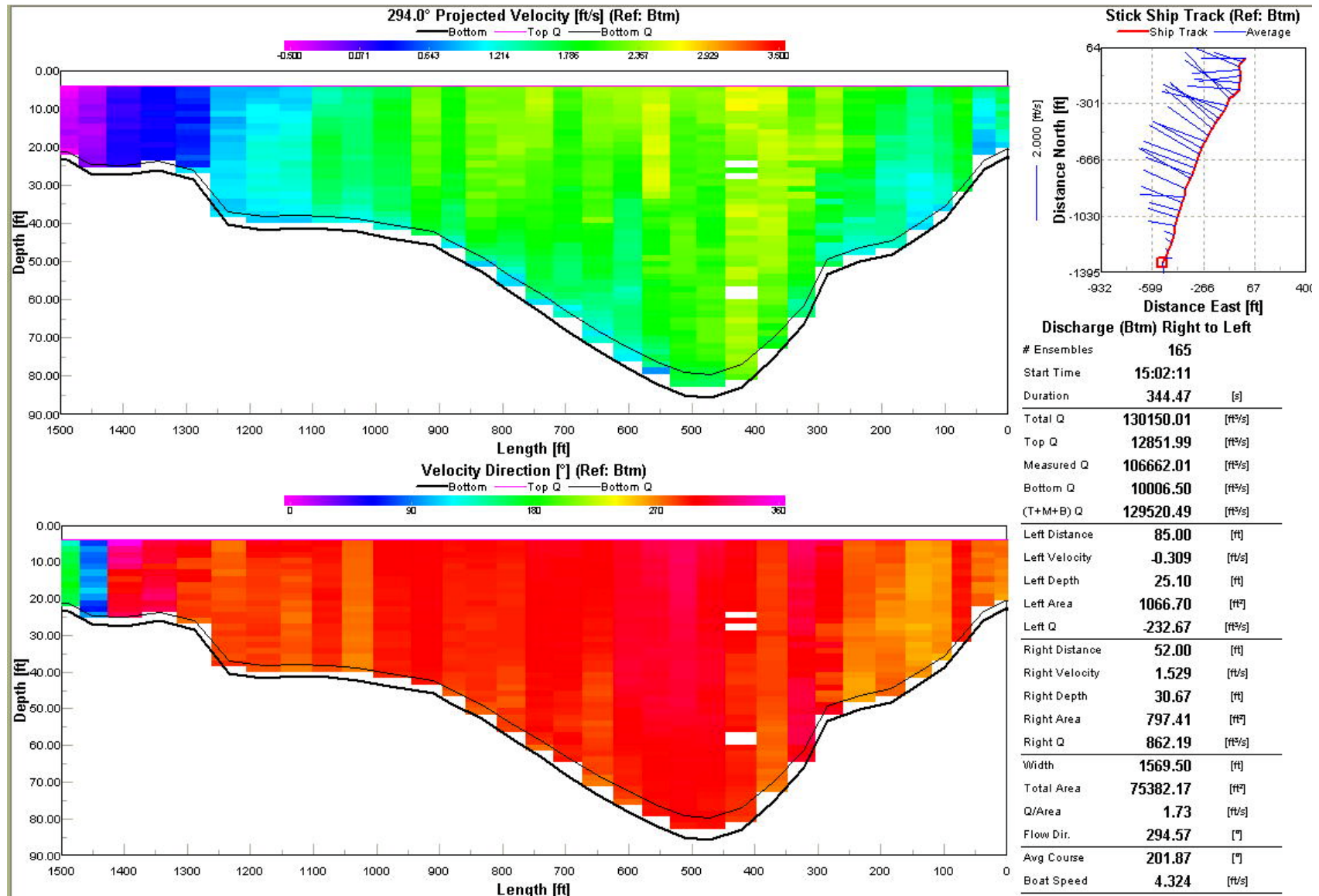
Transect 10 at 13:35 hours – River Mile 7.8



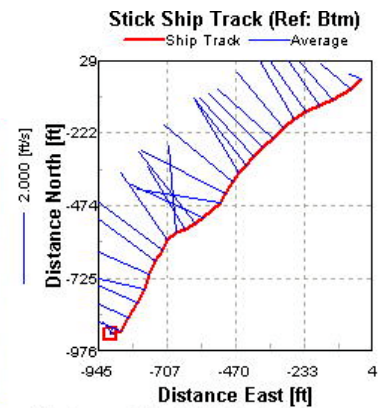
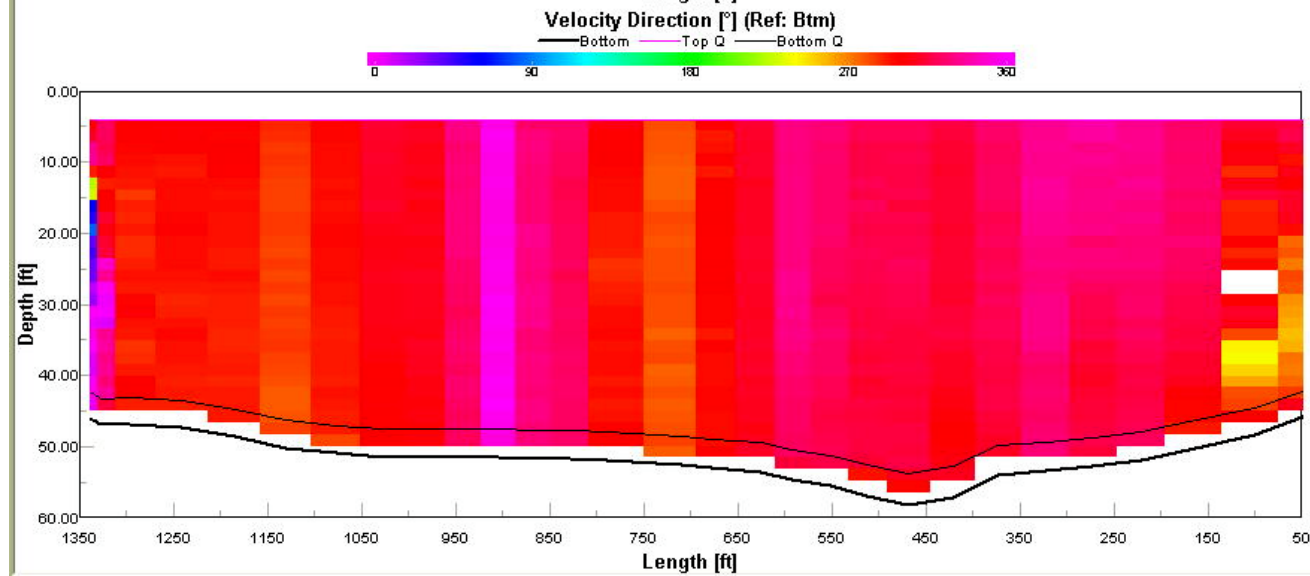
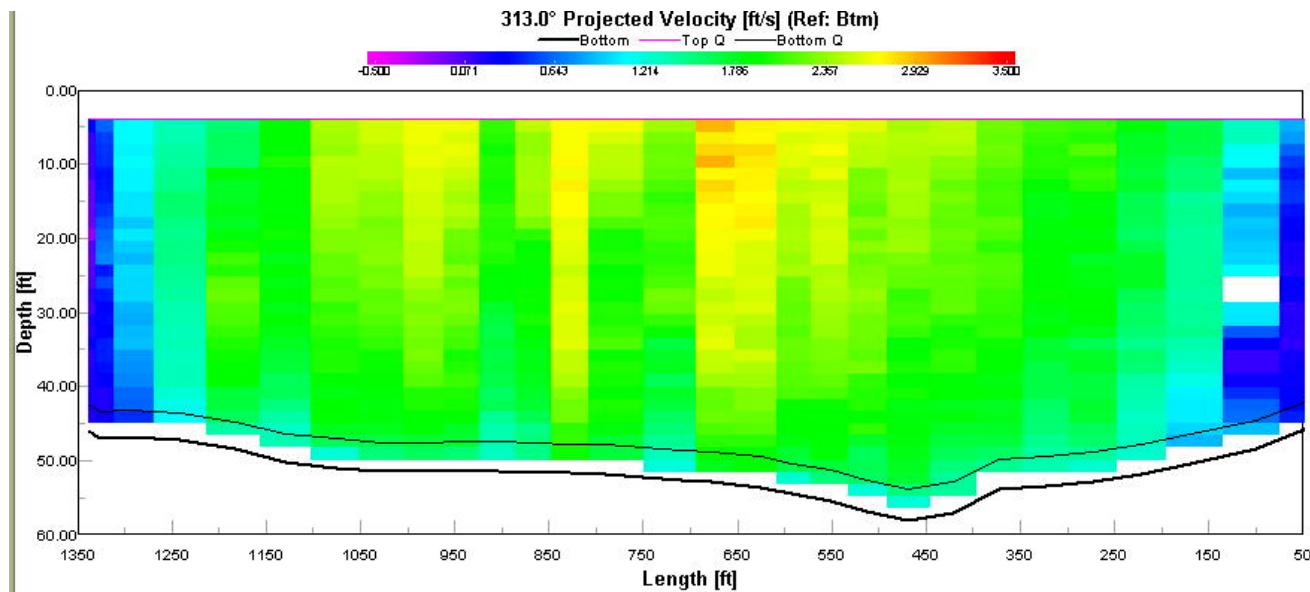
Transect 11 at 13:55 hours – River Mile 8.0



Transect 12 at 14:11 hours – Entrance to Swan Island Lagoon



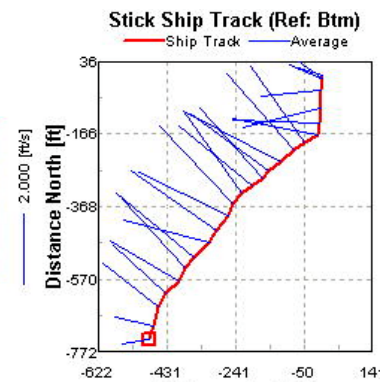
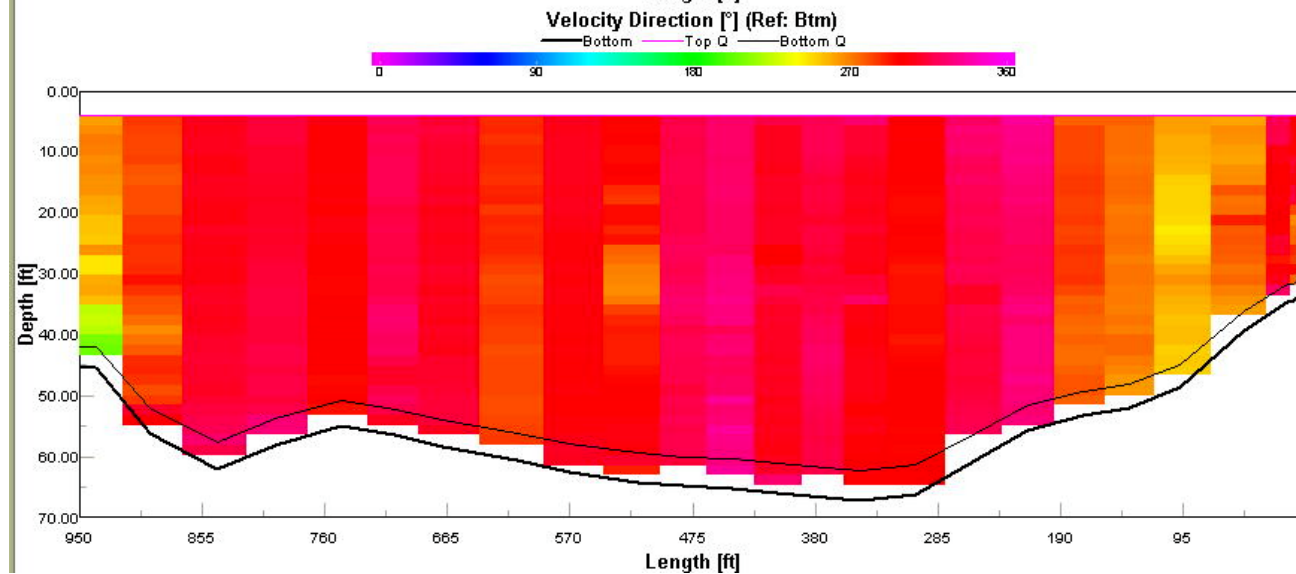
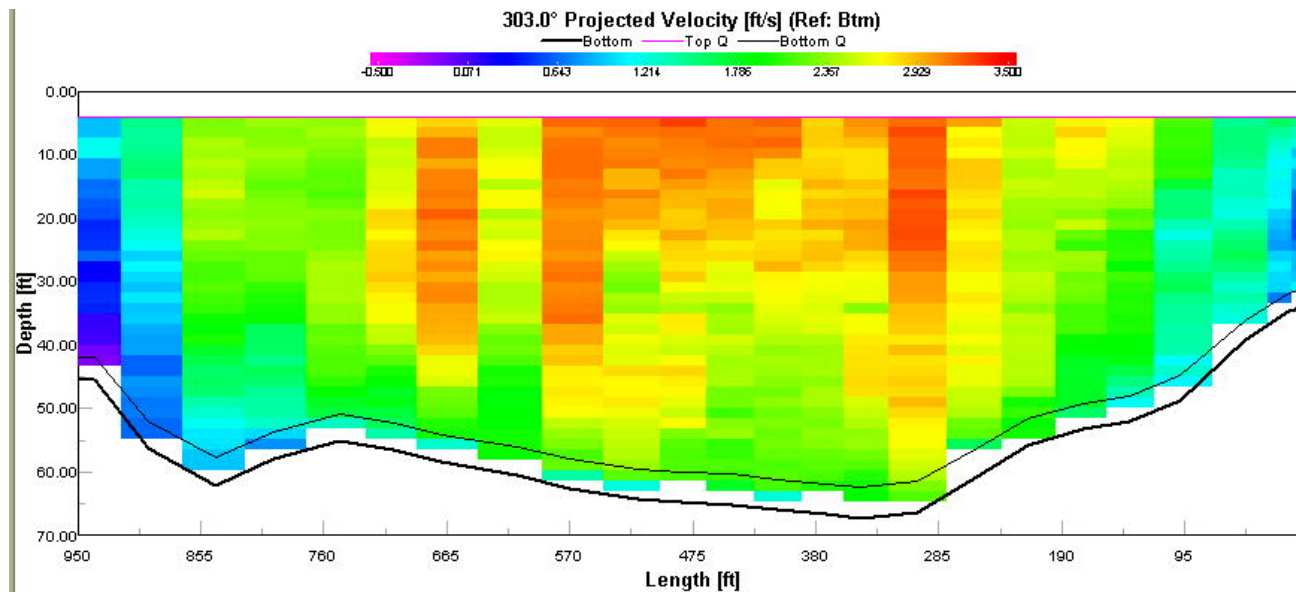
Transect 14 at 15:01 hours – River Mile 9.6



Discharge (Btm) Right to Left

# Ensembles	142	
Start Time	15:23:33	
Duration	296.87	[s]
Total Q	129274.53	[ft ³ /s]
Top Q	12174.23	[ft ³ /s]
Measured Q	104437.90	[ft ³ /s]
Bottom Q	11327.26	[ft ³ /s]
(T+M+B) Q	127939.39	[ft ³ /s]
Left Distance	80.00	[ft]
Left Velocity	0.525	[ft/s]
Left Depth	46.66	[ft]
Left Area	1866.29	[ft ²]
Left Q	692.71	[ft ³ /s]
Right Distance	48.00	[ft]
Right Velocity	0.802	[ft/s]
Right Depth	47.23	[ft]
Right Area	1133.51	[ft ²]
Right Q	642.43	[ft ³ /s]
Width	1412.64	[ft]
Total Area	69268.34	[ft ²]
Q/Area	1.87	[ft/s]
Flow Dir.	313.48	[°]
Avg Course	224.57	[°]
Boat Speed	4.497	[ft/s]

Transect 15 at 15:22 hours – River Mile 10.0



Discharge (Btm) Right to Left

# Ensembles	124
Start Time	15:43:53
Duration	259.60 [s]
Total Q	129181.16 [ft ³ /s]
Top Q	11111.21 [ft ³ /s]
Measured Q	105679.19 [ft ³ /s]
Bottom Q	10010.09 [ft ³ /s]
(T+M+B) Q	126800.49 [ft ³ /s]
Left Distance	80.00 [ft]
Left Velocity	1.015 [ft/s]
Left Depth	52.33 [ft]
Left Area	2093.27 [ft ²]
Left Q	1502.84 [ft ³ /s]
Right Distance	79.00 [ft]
Right Velocity	0.929 [ft/s]
Right Depth	33.85 [ft]
Right Area	1336.95 [ft ²]
Right Q	877.84 [ft ³ /s]
Width	1035.74 [ft]
Total Area	54405.82 [ft ²]
Q/Area	2.37 [ft/s]
Flow Dir.	303.83 [°]
Avg Course	213.19 [°]
Boat Speed	3.612 [ft/s]

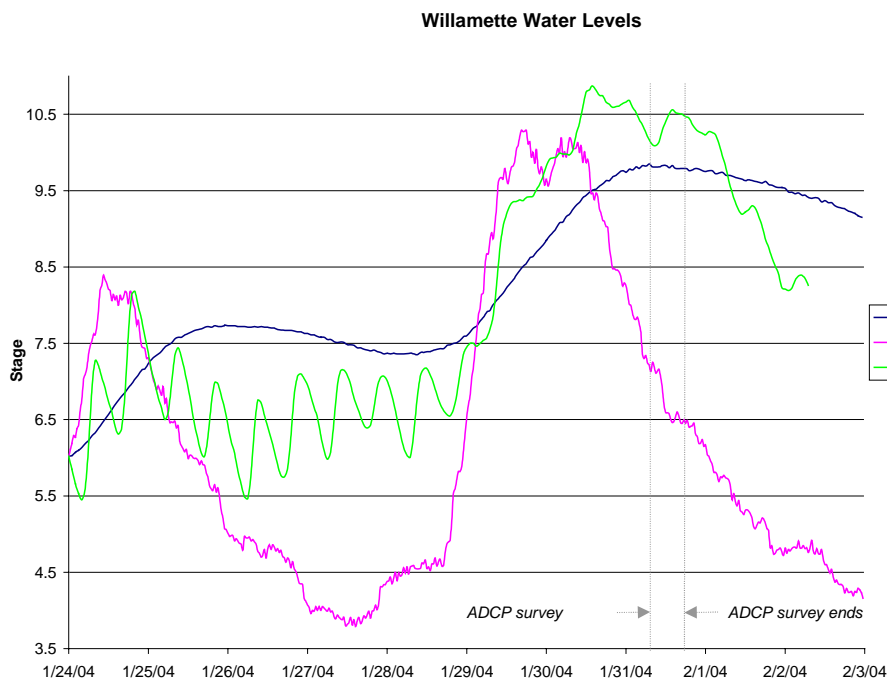
Transect 16 at 15:43 hours – River Mile 11.0

APPENDIX B

Supporting Hydrologic and Water Level Data

Willamette River Water Levels

Water flow through the Portland Harbor was evaluated respective to water height. Data for 'Clackamas at Oregon City', 'Willamette above the falls at Oregon City' and 'Willamette at Portland' were used during the analysis. Data were plotted for a common time period for the three stations, January 24th through February 2nd 2004. Data from the Clackamas River and the Willamette River above the Oregon City Falls were adjusted to a scale relative to the Willamette River at Portland (at noon on January 24th). The figure below graphically displays the water level at the three sites over a nine-day period



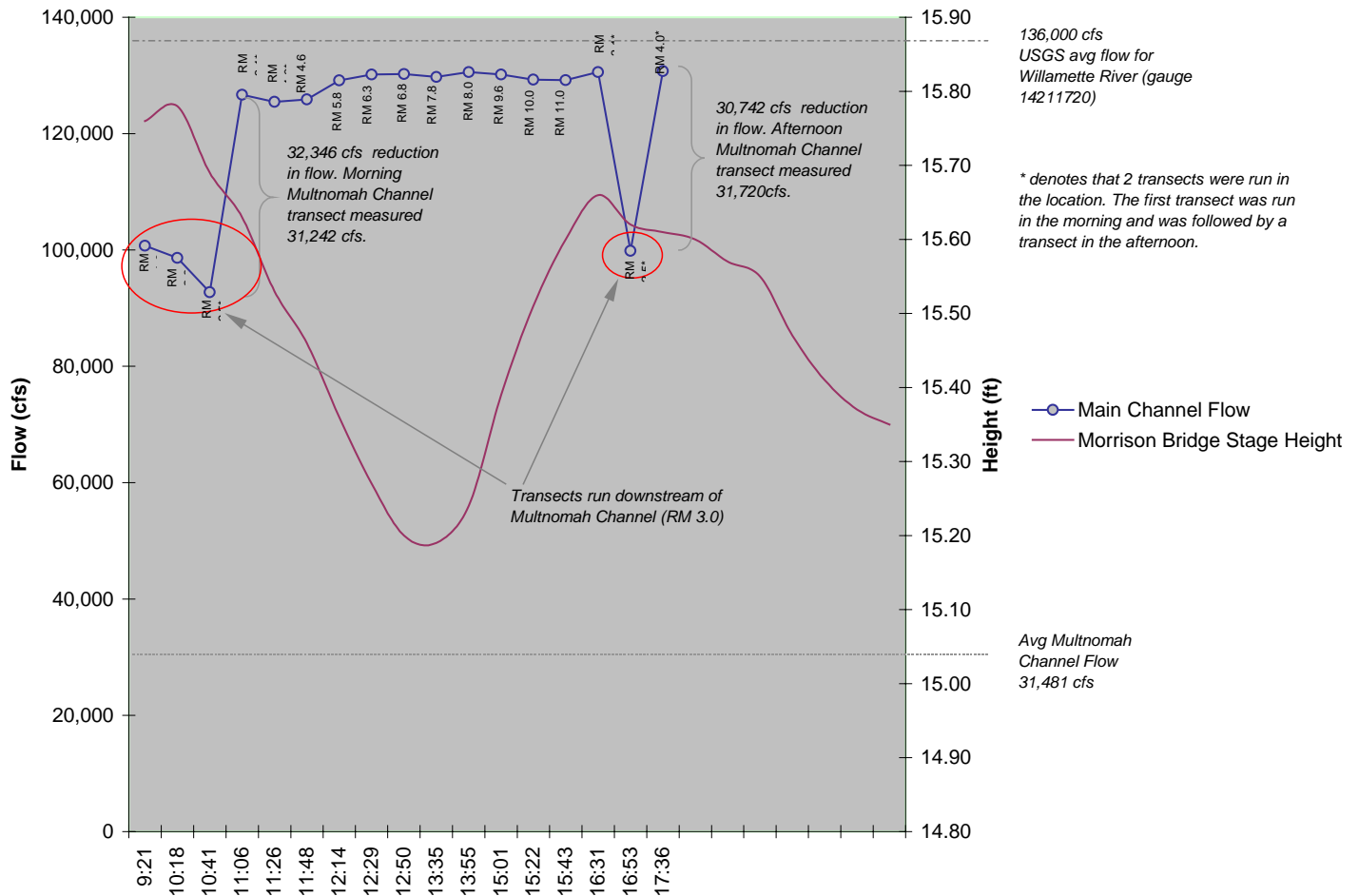
Gauge observations along the Willamette River with resect to ADCP transects

Morrison Bridge Gauge Observations at River Mile 12.8					Staff Gauge Observations			ADCP Transects			
Date	Time (PDT)	Morrison Gauge	CRD	NAVD88	Location	CRD	NAVD88	Transect Number	Flow (cfs)	River Mile	Location
1/31/2004	0:00	10.66	10.36	15.76							
1/31/2004	1:00	10.68	10.38	15.78							
1/31/2004	2:00	10.59	10.29	15.69							
1/31/2004	3:00	10.53	10.23	15.63							
1/31/2004	4:00	10.43	10.13	15.53							
1/31/2004	5:00	10.36	10.06	15.46							
1/31/2004	6:00	10.26	9.96	15.36							
1/31/2004	7:00	10.17	9.87	15.27							
1/31/2004	8:00	10.10	9.80	15.20							
1/31/2004	8:06				Terminal 5 RM 1.0	9.85	14.55				
1/31/2004	9:00	10.09	9.79	15.19	Terminal 5 RM 1.0	9.80	14.50				
	9:20							1	100723	1.0	
1/31/2004	9:57				Terminal 5 RM 1.0	9.50	14.20				
1/31/2004	10:00	10.14	9.84	15.24							
	10:18							2	98635	2.0	
	10:41							3	92749	2.5	Below Mult. Channel
1/31/2004	11:00	10.29	9.99	15.39							
	11:01							17	31242		Multnomah Channel
	11:06							4	126700	3.1	Above Mult. Channel
	11:26							5	125474	4.0	Above Mult. Channel
	11:48							6	125897	4.6	T-4 Slip 3
1/31/2004	12:00	10.41	10.11	15.51							
	12:14							7	129165	5.8	St. John's Bridge
1/31/2004	12:25				US Moorings RM 6.0	9.90	15.10				
	12:29							8	130142	6.3	
	12:50							9	130255	6.8	Willamette Cove
1/31/2004	13:00	10.50	10.20	15.60							

Morrison Bridge Gauge Observations at River Mile 12.8					Staff Gauge Observations			ADCP Transects			
Date	Time (PDT)	Morrison Gauge	CRD	NAVD88	Location	CRD	NAVD88	Transect Number	Flow (cfs)	River Mile	Location
	13:35							10	129757	7.8	
	13:55							11	130572	8.0	
1/31/2004	14:00	10.56	10.26	15.66							
	14:11							12	63		Swan Is. Lagoon
1/31/2004	15:00	10.52	10.22	15.62							
	15:01							14	130150	9.6	
1/31/2004	15:11				Terminal 2 RM 10.0	10.00	15.30				
	15:22							15	129274	10.0	
	15:43							16	129181	11.0	
1/31/2004	16:00	10.51	10.21	15.61							
1/31/2004	16:11				US Moorings RM 6.0	9.95	15.15				
	16:31							4	130580	3.1	Above Mult. Channel
	16:53							3	99838	2.5	Below Mult. Channel
1/31/2004	17:00	10.50	10.20	15.60							
	17:15							17	31720		Multnomah Channel
	17:36							5	130738	4.0	Above Mult. Channel
1/31/2004	18:00	10.47	10.17	15.57							
1/31/2004	18:02				Terminal 5 RM 1.0	9.9	14.60				
1/31/2004	19:00	10.45	10.15	15.55							
1/31/2004	20:00	10.37	10.07	15.47							
1/31/2004	21:00	10.31	10.01	15.41							
1/31/2004	22:00	10.27	9.97	15.37							
1/31/2004	23:00	10.25	9.95	15.35							

Time Series Comparison between Measured Flow and Water Levels

The effect of tide on flow is evident in the graphic below. Notice the inverse relationship between the amount of flow at each transect and the water level height. As the tide goes out, there is less impoundment of water within the channel (less resistance) and flow increases. Also notice the reduction of flow from transects upstream and downstream of the Multnomah Channel. The approximate 31,000-cfs reduction is roughly equal to the flow measured in Multnomah Channel at transect 17. At 11:10 the flow measured by the ADCP was 31,242 cfs and at 17:15 the flow was measured to be 21,720 cfs.



APPENDIX C

DEA HYDRO SURVEY LOGS

DEA HYDRO SURVEY LOG

Page 1 of 5

Day No.: _____ Operations: ADP SURVEY ~ WILLAMETTE (COLUMBIA R → FREEHART BR)
Senior Hydrographer: MMW Watch Stander: _____
Contract Number: INTC0000-0001 Work Order: _____
Locality: WILLAMETTE RIVER
Sub-locality: CONFERENCE W/ COLUMBIA TO FREEMONT BRIDGE
Sheet: _____ Registry: _____ Sheet Scale: _____

Horizontal Control

Primary Positioning System: DGPS Serial No.: _____
Secondary Positioning System: _____ Serial No.: _____
Differential Reference Station: _____ Station ID: _____
Horizontal Datum: CRN SPLS Projection: NAD83 Units: METERS
Central Meridian: _____

Vertical Control

Gauge Location: _____ Vertical Datum: _____

Instrumentation

ADP Multibeam Sonar: N/A WORKING 1200 KHZ Serial No.: 2084
Single Beam Echosounder: N/A Serial No.: _____
Motion Reference System: POS/MV Serial No.: _____
Vessel Heading Instrument: POS/MV Serial No.: _____
Primary CTD Instrument: N/A Serial No.: _____
Secondary CTD Instrument: N/A Serial No.: _____
Primary Acquisition Software: WINRIVER Version: _____
Secondary Acquisition Software: HYDRACK MAX 2.12 GROUND Version: _____
ADVANTAGE LASER HANDHELD EDM SN 12761

Vessel, Loading and Crew

Vessel: PRESTON Vessel Length: 28' Vessel Pilot: RRJ
Vessel Draft Readings: Forward _____ Port ¼ _____ Starboard ¼ _____
ADP Multibeam Draft on mount: 56cm + 8cm = 64cm at Roll Angle: 0
Crew: DEA: RRJ, MMW

DEA HYDRO SURVEY LOG

page 2 of 5Date of Survey: 01/31/04Weather: 90% c/kSeas: —

TRANSECT

Time	Gage	RPM	line	Azimuth	Remarks
0730					ARRIVE @ FRED'S MARINA, MAKE PRESTON READY FOR SEA - SYSTEMS UP ADDED ODOM DEVICE TO HYPACK FOR NAV.
0806	9.85				C-TERM 5 DEA STAFF FOR PORT OF PORT.
0818					DRAFT 8cm TO TOP OF PLATE, MOUNT HAS NOT BEEN ALTERED SINCE YESTERDAYS CALIBRATIONS. PC CLOCKS SYNCED
0822		800	1	320°	RTO L 85' FROM R BANK @ START 110' @ L BANK (EOL) TOTAL Q 21055.282 DISCHARGE R->L
0832		800	1	130°	LTOR 105' TO BANK (L) 85' @ EOL R BANK
0842		800	1	320°	RB 87' BOL R->L ABORT LINE D/T TRAFFIC
0847		800	1	320°	BOL @ RB, RL, 95' TO RB EOL @ LB 120' TO LB
					DATA FOR LR + RL DO NOT MATCH WITHIN 5% (ABOUT 7000%) SET COMPASS VARIATION TO 19° FROM 19°
0900	9.8				C-TERM 5
0921		800	1	320°	BOL @ RB, RL, 100' TO RB EOL @ LB 98'
0933		800	1	120°	BOL @ LB, LR, 120' TO LB EOL @ RB 60' 19.5°
					SET COMPASS VARIATION BACK TO 19° FROM 19°
0957	9.5				C-TERM 5
1010					PERFORMED COMPASS ERROR CALIBRATION ERROR WAS 2.7° NOW 0.9° ON 2ND PASS ~SEE LOG FILE COMPASS-CAL.TXT
1017		800	2	130°	BOL @ LB, LR, 180' TO LB EOL @ RB
1028		800	2	300°	BOL @ RB R-L, EOL @ 170' TO LB
1041		800	3		BOL @ LB, LR, 200' TO LB EOL RB 75' TO RB

RB - RIGHT BANK
LB - LEFT BANK
BOL - BEGIN. OF LINE
EOL - END OF LINE

D/T - DUE TO
RL - RIGHT BANK TO LEFT BANK
LR - LEFT BANK TO RIGHT BANK

DEA HYDRO SURVEY LOG

page 3 of 5Date of Survey: 01 / 31 / 04FROM UPSTREAM 5-10KHS
Weather: OKSeas: < 1/2'

Time	Gage	RPM	Line	Azimuth	Remarks
1059		800	17	10°	BOL @ LB 155' MULTNOMAH CHANNEL ABORT LINE
1101		800	17	10°	BOL @ LB 145' MULTNOMAH CHANNEL EOL 130' TO RB
1106		800	4	85°	BOL @ LB 245' OBS. @ BOL (DOLPHINS) EOL 05' TO RB
1126		800	5	250°	BOL @ RB 210' EOL 140'
1134		800	5	74°	BOL @ LB 117' EOL
1148		800	6		BOL @ LB
1148	10.0				EOL @ RB 65' FND @ EOL (WHO'S?)
1149	10.0				GREEN STAFF ~ NOT USACE'S
1214		800	7	57°	BOL @ LB 75' 3394 - STARTING POINT ST. JOHN'S BANK EOL 200'
1225	9.9				2 USACE STAFF; VS MOORINGS
1229		800	8	33°	BOL @ LB 190' MKIE ON STANDBY OFFLINE D/T FISHING BOAT EOL @ RB 70'
* 1237		800	8		BOL @ RB 120' EOL
1250		800	9	41°	BOL @ LB 65' EOL @ RB 165'
1258		800	9	221	BOL @ RB 140' EOL @ LB 55'
1320		800	10	48°	BOL @ LB 130' EOL @ RB 76' NO GPS @ EOL ON WINNIEVER BUT OKAY ON POS/MV !! 1mm RESTART WINNIEVER ~ OKAY NOW
1335		800	10	228	BOL @ RB 70' OFF LINE D/T TRAFFIC EOL @ LB 95'
1352		—	11	60°	TESTING MOVING BOTTOM ~ BOAT SPEED SHOWS = +/- 0.1 FT/S
1355		800	11	42°	BOL @ LB 142' EOL @ RB 30'
1407		800	12	13°	* BOL @ LB 5' OFF PIER/INSIDE WATERWAY EOL @ RB 60'

NOTE: KEYED TO ~~INCREASING~~ L/R
BOL STARTS @ LB NOT RB EDIT
EOL STARTS @ DR NOT L/R EDIT

DEA HYDRO SURVEY LOG

page 4 of 5Date of Survey: 1 / 31 / 04Weather: o/c RAINSeas: 2 < 1/2' chop

Time	Gage	RPM	Line	Azimuth	Remarks
1411					BOL @ RB 60' INSIDE WATERWAY EOL @ LB
1416					FALSE START - ABORT
1418		800	11	222	BOL @ RB 60' (55'?) ~ ABORT D/T WAKE 1 1/2 FT
1427		800	11	222	BOL @ RB 70' NOTE SWELL @ ENG. 1700 INCREASED RPM TO 900 @ ENG. 1706 BEING BLOWN OFF COURSE
1454		800	14	34	BOL @ LB 109' DATA GAP @ ENG. 2366 EOL @ RB 36'
1501		800	14	215	BOL @ RB 52' RPM @ 1000 @ ENG. 2560 EOL @ LB 85'
1511	10.35				USACE @ FIRE DOCK 10.35
1511	10.00				TERM 2 PORT OF PORT 10.00
1515		800	15	48	BOL LB 90' UNDER PIER TO BULKHEAD @ ENG. 2978 RPM = 1000 EOL @ RB 45'
1522		1000	15	228	BOL @ RB 48' EOL @ LB 80' TO BULKHEAD (UNDER PIER) + 10' TO DOCK ON PILING S
1539		1000	16	49	BOL @ LB 62' EOL @ RB 76' 20' FROM COR OF PILING
1543		1000	16	229	BOL @ RB 79' 25' FROM COR OF PILING EOL @ LB 71'
1552					ADCP UP ~ STEERING TO TRANSECT 4
1611	9.95				USACE STAFF @ US BRIDGES
1616	10.1				GREEN STAFF SAME AS 1149 OBS.
1628					ADCP DOWN DRAFT ~ 8cm (ROUGH)
1631		1000	4	265	BOL @ RB 125' EOL @ LB 240'
1639		1000	4	85	BOL @ LB 240' EOL @ RB 90'
1653		1000	3	285	BOL @ RB 87 92' EOL @ LB 200'
1700		1600	3	105	BOL @ LB 200'

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Seas: $\angle 1/2'$ chop[illegible]